U. S. DEPARTMENT OF AGRICULTURE

OFFICE OF EXPERIMENT STATIONS

W. O. ATWATER, DIRECTOR

EXPERIMENT STATION RECORD

VOLUME 2, AUGUST, 1890-JULY, 1891

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Communications intended for this Office should be addressed to the SECRETARY OF AGRICULTURE, for the *Office of Experiment Stations, Department of Agriculture, Washington, D. C.*

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U. S. DEPARTMENT OF AGRICULTURE
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EXPERIMENT STATION RECORD

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EXPERIMENT STATION RECORD.

Vol. 2. AUGUST, 1890. No. 1.

EDITORIAL NOTES.

With the beginning of the second volume of the EXPERIMENT STATION RECORD two new features are introduced. The one consists of items of news from the stations, under the title of Experiment Station Notes; the other is the including of the Canadian stations with those of the United States in the abstracts of bulletins and reports.

The Experiment Station Notes are compiled from reports received from the stations and from other sources. It is hoped that they will prove a helpful means for keeping the stations advised of one another's work and plans and for showing the general public more of the spirit and tendencies of the stations, the kinds of work they are doing, the aid and recognition they are receiving, and the advances they are making. That our Canadian neighbors are making such noteworthy progress is a matter of congratulation, not only for them but for us also. Their work will be useful to us and ours to them.

During 1889 some two hundred and eighty reports and bulletins were published by the stations in the United States. They were estimated to aggregate about 10,000 pages. It seems reasonable to expect that the number and bulk of the publications in 1890 will be still larger. Even now the current publications are more than can be followed up by any single individual. What will be the difficulties of the future investigator and student who shall be obliged to search through the records of experiments tried, of results tested, of conclusions overthrown, in the attempt to gather the facts needed to form a judgment, prepare an address, write an essay, or plan a research? This difficulty has been foreseen and provision has been made for meeting it by means means of the publications of this Office.

The system of experiment station publications is briefly this: the individual stations publish annual reports and frequent bulletins, which are intended to bring promptly to the farmers of their own States prac-

tical results they have gained, and to give full details of management and of scientific work especially for the benefit of the stations and investigators. The publications of the Office of Experiment Stations are to collate, crystallize, and distribute the product of the whole work.

But this system, well-rounded as it is, is lacking in one particular. It does not fully meet the needs of the farmers of the country. Much of the work of each station is valuable to the farmers of many States. No station can undertake the study of all, or even all the most important, problems of its own State. Many problems are being investigated by several stations. Many citizens are therefore as much interested in work done in other States as in that done in their own. But the stations can distribute only a few of their publications outside of their own State limits, nor could busy practical men utilize all of the hundreds of bulletins and reports which appear each year if they had them. The technical publications of the Office of Experiment Stations can not be made to serve the purpose without changes which would seriously injure their usefulness for the purposes for which they were intended, and without an expense too great to be assumed.

This lack is being felt more and more. The Office of Experiment Stations has attempted to meet it by planning a series of Farmers' Bulletins, to contain brief, clear, practical statements of the more important results of investigations in the several States and to be distributed in large numbers to farmers throughout the Union. Two numbers have been issued. It is hoped that the means at the disposal of the Department will suffice for a liberal support of these bulletins.

Farmers' Bulletin No. 1 was entitled "The What and Why of Agricultural Experiment Stations." Its purpose, as expressed in the title, was to explain what experiment stations are and how they are useful; to give an outline of the history of the movement in this country and in Europe; and to show the present status of the American stations. An edition of 50,000 was printed. Calls for 25,000 more were received from stations which desire to distribute them to their constituents in their respective States, but the means available for printing were not sufficient to meet the demand. Farmers' Bulletin No. 2 is entitled "The Work of the Experiment Stations." It contains short articles on better cows for the dairy, fibrin and bacteria in milk, alfalfa, silos and silage, and co-operative field experiments with fertilizers. An edition of 150,000 has been printed, of which 75,000 copies are to be placed at the disposal of members of Congress. The rest are to be distributed from the Department and stations. It is the purpose to supply these to the correspondents of the stations so far as circumstances will allow. Several stations have furnished this office with copies of their mailing lists and the bulletins will be sent to them. Stations desiring Farmers' Bulletin No. 2 for circulation are invited to confer with this Office.

REPORT OF EXPERIMENTAL FARMS IN CANADA FOR 1889.

As stated in detail in Vol. I, page 245, of the EXPERIMENT STATION RECORD, the Canadian Government, in the year 1886, made provision for the establishment of five experimental farms in different parts of Canada. They are under the general management of Prof. William Saunders, director of experimental farms. The principal one is the Central Experimental Farm, which is located in Ottawa and serves for the provinces of Ontario and Quebec. Of the other four, that for the maritime provinces is located at Nappan, Nova Scotia; that for Manitoba at Brandon; that for the Northwest Territories at Indian Head, and that for British Columbia at Agassiz.

REPORT OF DIRECTOR OF EXPERIMENTAL FARMS, W. SAUNDERS (pp. 5–41).—"The progress made during the past year at the several experimental farms has been such as to attract the general attention of the agricultural community." Many persons have visited the "farms" and a large correspondence has been carried on. The Central Experimental Farm alone has received nearly 7,000 letters during the year, and 41,584 reports and bulletins and 3,662 packages of grain and seeds have been distributed. The officers of the experimental farms have been frequently called upon to attend farmers' institutes and other meetings of farmers. Accounts are given of visits made by the director to New Brunswick, Nova Scotia, Ontario, Prince Edward Island, Quebec, Manitoba, the Northwest Territories, and British Columbia, during which the several experimental farms were inspected, farmers' meetings attended, and the agricultural needs of the different regions carefully studied. Reference is also made to the wise policy recently adopted by the Canadian Pacific Railway "of setting apart at each of the more important railway stations through the sparsely settled portions of the western plains, about an acre of land for garden purposes."

REPORT OF WORK AT CENTRAL EXPERIMENTAL FARM (pp. 17–41.)—*Seed testing and distribution* (pp. 17–25).—During the year 933 samples of seeds of grain and vegetables sent in by farmers were tested. A summary of the results is given in the report. The percentage of vitality varied from 0 to 100.

The tests of frozen grain have been especially useful to the farmers of the Northwest, and the timely information given has no doubt saved many from the disappointment which would in most cases have resulted from the use of inferior seed. For while oc-

casional instances have been reported of good crops being obtained where frozen grain has been used for seed, the bulk of the evidence appears to be on the other side, and few farmers care to run the risk which always attends the sowing of injured seed. In testing frozen grain not only was the percentage of germinating power returned, but information was also given regarding the vigor or weakness of growth. It was often observed that where frozen grain had a fair percentage of germinating power its vitality was so far injured that a very weakly growth was made. These weaker plants sometimes gain strength and vigor rapidly in the rich soil of the prairies when the weather is favorable, but if unfavorable conditions prevail their growth is usually slow and stunted and the crop uneven in ripening.

Rust was alarmingly prevalent in Ontario and to some extent in Quebec and the maritime provinces, shriveling the grain and weakening its vitality, especially in the case of oats. Farmers are invited to send samples of doubtful seed to the farm to be tested.

Two thousand seven hundred and sixty 3-pound packages of seed grain were distributed to farmers of the Dominion, including the Ladoga wheat; seven varieties of two-rowed barleys, viz., English Malting, Carter's Prize Prolific, Beardless, Danish, Chevalier, Danish Printice Chevalier, Peerless White, and Thanet; and three of oats, viz., Carter's Prize Cluster, Welcome, and Early Blossom. Extracts from the reports of farmers who tested these seeds are given. A limited number of tree seeds have also been distributed, including Manitoba maple, box-elder, elm, white ash, black walnut, and butternut.

Live stock (pp. 25–29).—Brief accounts are given of the pedigrees of the members of the farm herd, which includes Shorthorns, Ayrshires, Holstein-Friesians, Jerseys, and Polled Angus cattle, "in all fifty pure breed animals, to which may be added three grade cows and one grade heifer.

Experiments with wheat (pp. 30, 31).—Eight varieties of winter wheat and ninety-nine of spring wheat were tested. Tabulated notes are given for thirty-two spring and three winter varieties. Further details are reserved for a bulletin.

Experiments with barley (pp. 31, 32).—"The field experiments with barley have been carried on mainly with two-rowed varieties, such as are in favor in Great Britain for malting purposes." Tabulated notes are given for thirteen two-rowed varieties and four six-rowed varieties. A test made by a practical maltster and brewer is reported, in which a two-rowed barley from Scotland yielded about 13 per cent more of extract than six-rowed Canadian barley.

Experiments with oats (p. 33).—Tabulated notes on thirty-six varieties.

Experiments with Indian corn (p. 33).—Seventy varieties of corn have been tested, and the product has been converted into silage. Tests have also been carried on with this important crop at the experimental farms in Nova Scotia, Manitoba, and the Northwest Territories. Details will be given in a special bulletin.

Other crops.—Brief notes are given on five varieties of turnips, three of mangels, five of carrots, five of sugar-beets, and three of peas; on mixtures of grasses and clovers sown for permanent pasture, spring rye,

and eleven varieties of clovers and forage plants. Records were kept for three hundred and eighty-four varieties of potatoes, but the details of the tests are reserved for a special bulletin. "Among the newer potatoes the following deserve mention on account of their productiveness: Halton's Seedling, Dakota Red, Stray Beauty, Rosy Morn, Rural Blush, Lee's Favorite, Burpee's Superior, Early Albino, and Carter's King of Russets." Seeds of a variety of cereals and other products grown in the Himalayan Mountains are being tested. A list is given of forty-eight species of forest trees planted on the farm, and of ten species of shrubs and trees planted in hedges. A new office building and chemical laboratory, houses for seed testing and distribution, and for the farm implements, a granary, and a silo have been erected. Exhibits of the products of the experimental farms have been made in different parts of Canada. Meteorological stations have been established at each of the farms.

"During the greater part of the year Mr. J. A. Chicoyne, of Sherbrooke, Quebec, has been employed as a special agent to visit different portions of the province of Quebec, holding meetings among the farmers, and to deliver lectures to them in the French language on agricultural subjects. This has been done with the view of instructing them in regard to farm work and of encouraging them in the improvement of their farms. From the reports which have been received it would appear that the services rendered have been appreciated by the people."

Report of Chemist, F. T. Shutt, M. A. (pp. 42–58).—This includes analyses of soils, muds from Prince Edward Island, black mucks from Ontario, marls, "flue dust," wood ashes, poudrette, fish waste, gas lime, superphosphates, sugar-beets, and water. The new chemical laboratories and their equipment are described.

Report of Entomologist and Botanist, James Fletcher (pp. 59–92, illustrated).—This is chiefly devoted to an account of the work in entomology, including field investigations of insect pests and trials of insecticides, and includes notes on the Hessian fly (*Cecidomyia destructor*), grain aphis (*Siphonophora avenæ*), wheat-stem maggot (*Meromyza americana*), cut-worms, turnip flea beetle (*Phyllotreta vittata*), Mediterranean flour moth (*Ephestia kuhniella*), granary weevils (*Calandra granaria* and *C. oryzæ*), large red headed flea beetle (*Systena frontalis*), Fuller's rose beetle (*Aramigus fulleri*), and an insect injuring a wooden water pipe (*Macronychus glabratus*). The experimental grass plats are referred to. About 200 species of trees and shrubs have been set out.

Report of Horticulturist, W. W. Hilborn (pp. 93–96).—Brief notes on experiments with apples, pears, plums, cherries, grapes, currants, raspberries, blackberries, strawberries, radishes, lettuce, asparagus, and rhubarb.

Report of Poultry Manager, A. G. Gilbert (pp. 97–111).—This contains an account of observations at the farm with a number of

different breeds of hens, and of an unknown disease which destroyed many fowls in the vicinity of Ottawa in the summer of 1889, together with practical advice concerning the management of poultry and brief notes on fourteen different breeds of hens. Data regarding the setting and hatching of eggs, monthly growth of chickens, number of eggs laid by hens of different breeds, and weights of eggs singly and per dozen are given in tabular form. The following are given as "points to remember:"

(1) Make hens lay when eggs are dearest.

(2) Breed stock when eggs are cheap.

(3) Keep a non-sitting breed to lay when sitters are hatching, and pay expenses of latter.

(4) Breed as many chickens as possible and as early as possible. They all represent so much money.

(5) Keep all the pullets. They are worth $2 each as prospective early winter layers.

(6) Kill or otherwise dispose of all hens after three years of age.

(7) Breed the best flesh-formers for market. Feed them up to as great weight as possible.

(8) Well-fattened, well-dressed poultry will bring the best prices from the best customers.

(9) If not accustomed to poultry, begin with a small number. Learn to make a success of the few, then go on with a larger number.

(10) Do not neglect the little essentials to success, such as lime, gravel, meat plenty of clean water, green food, dust bath, etc., regularly supplied to layers.

(11) Keep strict account of every cent of expenditure and receipts. Charge the poultry with all expenses and credit them with all receipts. The droppings at 75 cents per barrel will go a long way to pay feed.

(12) Market gardeners and dairymen are particularly well situated to permit of their dealing profitably in poultry. The former have spare time in winter; the latter are among the best customers in the city every day.

Report of Superintendent of Experimental Farm for the Maritime Provinces, W. M. Blair (pp. 112–122).—Tabulated notes are given of results of tests of 9 varieties of wheat, 17 of oats, 13 of barley, 3 of buckwheat, and 103 of potatoes. There are also brief notes on 13 varieties of corn, 7 of turnips, 3 of mangels, 4 of carrots, 7 of tomatoes, 10 of strawberries, 7 of raspberries, 3 of blackberries, 3 of gooseberries, 8 of currants, 11 of cabbages, 6 of cucumbers, and 22 of forage plants. In a small experiment in planting whole potatoes and pieces of different sizes the whole potatoes gave much the largest yield. Experiments with different fertilizers on oats, turnips, and corn, are also reported. A superintendent's residence, workman's cottage, and large barn were nearly completed when the report was prepared.

Report of Superintendent of Experimental Farm for Manitoba, S. A. Bedford (pp. 123–132).—Tabulated notes aré given for tests of 17 varieties of wheat, 20 of oats, 15 of barley, 6 of native grasses, 23 of cultivated forage plants, 11 of corn, 47 of potatoes, 13 of turnips, 4 of mangels, and 6 of strawberries. There are also brief statements regarding experiments with grapes, currants, gooseberries, raspberrries, blackberries, forest trees and shrubs, and in apiculture.

REPORT OF SUPERINTENDENT OF EXPERIMENTAL FARM FOR THE NORTHWEST TERRITORIES, A. MACKEY (pp. 133–150).—Experiments with wheat are reported, including tests of 16 varieties from India and of three grades of frozen Red Fife wheat. Smut, which was very prevalent throughout the Territories, did not affect the Indian wheat. Tabulated notes are given for 31 varieties of rye, including 6 from high elevations in India; 32 of barley, including 12 from India; 22 of oats, and 40 of potatoes. Brief mention is also made of experiments with forage plants, flax, buckwheat, turnips, mangels, carrots, apples, pears, plums, cherries, currants, raspberries, blackberries, gooseberries, grapes, and strawberries. Thousands of forest trees and shrubs have been set out in wind-breaks and nursery rows, and experiments are in progress with seedling trees. The farm buildings thus far completed include houses for the superintendent, horticulturist, and foreman, a horse stable, and a barn.

REPORT OF SUPERINTENDENT OF EXPERIMENTAL FARM FOR BRITISH COLUMBIA, T. A. SHARPE (pp. 151, 152).—Work on this farm was begun September 19, 1889. The report, therefore, includes only a brief account of preparatory operations. Orchard and small fruits, and about 8,000 forest trees have been planted.

ABSTRACTS OF BULLETINS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

Alabama College Station, Bulletin No. 10 (New Series), January, 1890 (pp. 15).

GRAPE CULTURE, J. S. NEWMAN.—"A most unprepossessing north hillside was selected for a vineyard." In one part of the vineyard the ground was very uneven, and in another part the soil had been so completely washed off that the surface was entirely bare of vegetation. An account is given of the preparation, planting, and cultivation of this vineyard, begun in 1886. Peas were planted among the vines for two years, and composts of cotton-seed meal, cotton-seed-hull ashes, acid phosphate, and kainit in different combinations have been used during four years. The third year the standard varieties, such as Concord, Ives, and Perkins, produced an average of 12 pounds per vine, or 4 tons per acre; and in 1889 nearly 7 tons of grapes of the different varieties were gathered from the experimental acre. This effort of the Station to promote the culture of grapes in Alabama has excited much interest and is felt to be an important matter. Two years' experience in the use of paper bags, as described in this bulletin, to protect the grapes against birds, insects, mildew, and black rot, has convinced the experimenters that this is an efficient and economic means of defending some varieties of grapes against these enemies. The expense involved in the use of the bags has averaged six-tenths of a cent per pound. "It is not profitable, however, to bag any except the choice bunches." Notes are given on thirty-nine varieties of grapes grown at the station. Berckman's (a new variety), Concord, Delaware, Goethe, Ives, Moore's Early, Niagara, Perkins, and Wyoming Red, are especially recommended for general culture.

Alabama College Station, Bulletin No. 11 (New Series), February, 1890 (pp. 13).

NOTES FROM THE EXPERIMENT STATION ORCHARD, J. S. NEWMAN.—

Peaches.—In March, 1885, thirty-six varieties of budded peaches were planted upon a sandy ridge, which produced in 1884 only 136 pounds of seed cotton per acre without manure. By the side of these twenty-two seedling trees were planted. Next to these one row was planted with seed from which a dozen healthy trees were grown and left where they sprang up. The object in view was to compare the productiveness, hardiness, and longevity of transplanted budded trees, transplanted seedlings,

and seedlings not transplanted, and at the same time to secure a record of the habits, pecularities, and merit of the varieties of budded fruit. * * *

The trees were all cut back to 2 or 3 feet when transplanted, and have been pruned each spring since by the classes in the school of agriculture. The objects had in view in pruning have been:

(*a*) To train each tree to shade its own body to prevent sun-scald. (*b*) To distribute the growth of limbs uniformly around and above the body, to secure symmetry, and to have the weight of fruit uniformly distributed around the point of support. (*c*) To strengthen the limbs by shortening back, to enable them to sustain a crop of fruit. (*d*) To reduce the quantity of fruit by a judicious shortening of the shoots bearing the fruit-buds. (*e*) To so direct the growth that the crop of fruit could be gathered by a man standing upon the ground.

All of these objects have been attained in nearly every specimen. Notwithstanding the immense crop of fruit borne last summer the trees were neither broken nor rendered ill-shapen, while trees not pruned were often stripped of all their branches.

Observations indicate that seedlings have failed to bear as often as budded trees, and that there has been no uniform relation between the date of flowering and of ripening. Brief notes on thirty-six varieties are given, and these varieties are classified with reference to their use for shipping, canning, and home consumption.

Plums.—Notes on twelve varieties.

Alabama College Station, Bulletin No. 12, February, 1890 (pp. 15).

CO-OPERATIVE SOIL TESTS WITH FERTILIZERS, J. S. NEWMAN.—In the season of 1889, nine farmers having typical soils in as many counties were selected to co-operate with the director in studying the needs of these soils, and fertilizers were furnished with directions for their application and for the arrangement of plats. The fertilizers and amounts per acre were—for nitrogen, sulphate of ammonia, 80 pounds, nitrate of soda, 100 pounds, and cotton-seed meal, 200 pounds; for phosphoric acid, dissolved bone-black, 200 pounds; and for potash, kainit, 100 pounds. Green cotton seed, 960 pounds per acre, alone and in combination with acid phosphate, and stable manure, 3,000 pounds per acre, were also used. The fertilizers were applied singly and in various combinations to fifteenth-acre plats planted with cotton, without provision for duplication. Some of the experiments proved to be of little value, owing to mistakes and omissions; others, three of which are reported, indicate with some clearness that phosphoric acid is the ingredient chiefly needed on the soils tested—sandy and brown loam, with clay subsoil.

Tests of varieties of cotton.—Seed of eleven varieties of cotton was sent to each of the experimenters. In the only successful test reported Peerless led in early maturing, and in yield (1,080 pounds per acre) was equaled only by Jones' Improved, though closely followed by Wellborn's Pet and Zellner.

Careful directions for repeating the tests during the present season are included in the bulletin.

Alabama Canebrake Station, Bulletin No. 7, February, 1890 (pp. 11).

FIELD EXPERIMENTS, W. H. NEWMAN, M. S.—

(1) *Cotton, test of varieties*.—Tabular record and notes on twelve varieties.

(2) *Cotton, comparative earliness from northern-grown seed.*—The experiment was made in the endeavor to find a "variety from some northern point that would mature a crop before attacked by the worms. Seeds were obtained from Somerville, Tenn., Carters, N. Ga., and Raleigh, N. C. The seeds from North Carolina were of an improved variety, and those from North Georgia and Tennessee were common. They were planted March 28, on one-third acre plats, in black slough bottom-land." The results from these seeds were sufficiently better than those from seeds grown at the station to justify a repetition of the experiment.

(3) *Peas and melilotus as fertilizers.*—A brief record of an inconclusive experiment to study the comparative value of peas and melilotus as fertilizers.

(4) *Pea vines as fertilizer for cotton.*—Report of an experiment on three one-tenth-acre plats. On one plat no pea vines were planted, on another they were left on the ground, and on the third they were cut for hay. The peas were followed by cotton. The results in this, as in other similar experiments at the station during the past five years, strongly favored the use of pea vines to restore fertility to worn-out soils, and implied that it is better to cut the vines for hay than to leave them on the ground. The increased yield by leaving the vines is small, and the land is much harder to prepare where the vines are left. From two to five tons of hay can be cut from one acre in vines. The increased cotton grown by leaving the vines to rot on the land was worth only $8.75, while the vines cured into hay would be worth not less than three times that sum. The effect of the vines upon crops after the first season has not been ascertained.

(5) *Corn, effect of fertilizers.*—The results obtained on nine plats where different fertilizers were compared with no manure, "were very uniform, and no increase can be attributed to the fertilizers." These results afford cumulative evidence that the commercial fertilizers can not be profitably used on the black prairie soils of the canebrake.

(6) *Corn, test of varieties.*—Tabular record for twenty varieties, including Brazilian flour corn.

(7) *Corn, thickness of planting.*—Corn was planted in four different degrees of thickness, the rows being from 4 by 2 feet to 4 by 5 feet apart, on black prairie bottom-land. The yield was decidedly in favor of the thick planting.

(8) *Pea vines as fertilizer for corn.*—The results of an experiment on three one-tenth-acre plats indicated no marked effect from the use of pea vines as compared with no manure.

California Station, Bulletin No. 85, February 15, 1890 (pp. 4).

OBSERVATIONS ON OLIVE VARIETIES, W. G. KLEE.—The following brief introduction is by Director Hilgard:

The increasing prominence of olive culture in this State gives importance to all light that can be thrown upon the subject, the more as the slow growth of the tree renders mistakes made in the selection of varieties both costly and difficult of rectification. It is therefore the intention of the station to subject both the growing trees and the fruit and its products to the most thorough comparative observation and investigation, as quickly as the material shall be obtainable. In the meantime, the observations of Mr. Klee appear of sufficient practical importance to justify their publication at this time.

It is evident that both with respect to the production of oil and that of pickled olives, the proportion of kernel to meat is a matter of no mean importance, when we see, as is shown below, that this proportion varies all the way from 8 to over 34 per cent. Some have the impression that the oil of the kernel or pit forms a considerable proportion of the product, but the investigation of this point made by Mr. L. Paparelli upon the common olive of Central Italy, showed this proportion to be as one to thirty, while in the Mission olive, noted for the rarity of sound kernels, the proportion was found by Mr. Ad. Sommer, of the University, as one to one hundred and sixty-two. Hence to the oil maker, as well as to the consumer of pickled fruit, the data given will be of some interest.

The account of the observations made by Mr. Klee relates to the growth of a number of varieties of olives during several years.

This is, of course, only the beginning of observations which will be continued for years to come. Nearly all the varieties enumerated are now growing at the four different experiment stations, viz., Berkeley, Paso Robles, Jackson, and Tulare. Those at Berkeley were planted five years ago, while those at the other stations were set out only a year ago, and thus afford but few data of value. Observations of the varieties growing on the grounds of the California Nursery Company, Niles, and at Fancher Creek Nursery, Fresno, were also made through the courtesy of their respective managers.

The tabular record includes data for sixteen varieties, on the name, age at planting, whether cuttings or grafts, diameter of stem or crown, height, and habit of growth and bearing, at Berkeley and elsewhere. Notes of measurements of fruit, etc., are also given for thirteen varieties and notes on growth and general behavior for eleven varieties.

Colorado Station, Bulletin No. 10, January, 1890 (pp. 15).

EXPERIMENTS WITH TOBACCO.—

Introduction, C. L. Ingersoll, M. S. (pp. 3, 4).—In 1884 a small amount of good tobacco was raised at the college, and in 1888 and 1889 larger experiments with this plant were conducted at the station. "The results of the two years' work are recorded briefly in this bulletin. The chemical analysis of the several varieties raised is also tabulated for comparison and reference, and shows a quality that is good from the chemical standpoint." The director believes that through these experiments another money-making crop will be added to the agriculture of the

State. The station deems it unnecessary to continue experiments in this line.

Field experiments with tobacco in 1889 (pp. 5–8).—This is an extract from the report of the station botanist and horticulturist for 1889. Havana, White Barley, and Golden Prior were the varieties grown, the first named on half an acre, and the others in single rows 100 feet long. Tests were also made on poor and rich soil, and the quality of the crop was determined by chemical analysis. The methods of cultivation, curing, and bulking are briefly described. "The tobacco grown from our own seed, raised here a year ago, proved to be much inferior to that grown from imported seed, and it would not pay to raise such tobacco. The experience of this year shows that nothing but Havana seed-leaf should be grown in this region. A fine Havana leaf will always command a ready sale at a good price." The net profit in 1888 was at the rate of $138.24 per acre; in 1889, $170.38.

Analyses, D. O'Brine, D. Sc. (pp. 9–15).—This includes brief statements with reference to the climate and fertilizers desirable for tobacco and the factors determining the burning quality of the weed, an analysis of the soil of the college garden, and a tabular record of analyses of samples of eighteen varieties of tobacco grown at the station in 1888 and 1889. For details and conclusions from the experiments of 1888 the reader is referred to Bulletin No. 4 of this station, and to the Annual Report for 1888. Among the general conclusions are that "Colorado-grown tobacco makes a cigar of fine flavor, with excellent burning qualities; that chemically these tobaccos were fully up to the average of tobaccos produced elsewhere;" and that "tobacco is a profitable crop for the farmers of Colorado to raise; one which, if well grown and cured, will add much to the productive wealth of the State."

Connecticut State Station, Bulletin No. 101, January, 1890 (pp. 4).

FERTILIZER ANALYSES.—"This bulletin contains some corrections of errors in Bulletin No. 100, besides analyses of six nitrogenous superphosphates, one of cotton-hull ashes and one of 'Hall's Coral Fertilizer.'"

Connecticut State Station, Bulletin No. 102, March, 1890 (pp. 7).

FUNGICIDES, R. THAXTER, PH. D.—This bulletin is designed to call the attention of farmers to the importance of gaining some practical knowledge of the use of fungicides and to furnish brief directions for this purpose. Formulas are given for the Bordeaux mixture and the ammoniacal carbonate of copper solution. Apparatus for spraying is described.

In the treatment of fungous diseases no general directions can be given which will apply in all cases, and information on the subject should be previously obtained from some reliable source. In general, however, it may be said that treatment should in the majority of cases be preventive rather than curative, the application being

effective only when made before the disease has appeared. An application of a strong ungicide to vines or trees during late winter or early spring is often useful by killing fungous spores adhering to them. For this purpose a Bordeaux mixture made as described, by using 10 pounds of sulphate of copper, 10 pounds of lime, and 25 gallons of water, may be employed; and a strong (25 per cent) solution of sulphate of iron has been found of advantage for the same purpose.

The apparatus for the application of fungicides is equally well adapted to the use of insecticides. If Paris green and London purple are to be used, they may in some cases be mixed with the fungicide solution in the usual proportions when a double treatment is desired.

Florida Station, Bulletin No. 8, January, 1890 (pp. 23).

FIELD EXPERIMENTS WITH LONG STAPLE OR BLACK-SEED COTTON, J. P. DE PASS (pp. 3–7).—Two experiments were planned to test the effects in one case of 250 pounds of black cotton-seed meal and 250 pounds of "pot ammoniac," and in the other, of 500 pounds of cotton-seed meal per acre, as compared with no fertilizers, on cotton planted on high, rolling, and sandy land. "In consequence of late planting, unskilled labor, protracted droughts in summer, and excessive rains in summer" the results were inconclusive.

WEEDS OF FLORIDA, J. C. NEAL, M. D. (pp. 7–16).—This contains a provisional list of the weeds of Florida, classed as "occasional," "aggressive," and "common." The "semi-tropical" species are distinguished from the others. Brief notes on a few varieties are given.

ANNUAL REPORT OF THE FLORIDA EXPERIMENT STATION, J. P. DE PASS (pp. 17–23).—This includes the report of the director on the farm, buildings, orchard, live stock, substations, and entomological and botanical collections of the station; the report of the chemist on the analyses of fertilizers, waters, soils, grasses, etc., made at the station in 1889; and the report of the treasurer for the fiscal year ending June 30, 1889.

Georgia Station, Bulletin No. 6, January, 1890 (pp. 16).

INTRODUCTION, R. J. REDDING (p. 81).—A brief account of the work begun at Experiment, near Griffin, under the new organization of the station. "The farm donated by the citizens of Spalding County, situated 1½ miles north of the city of Griffin, was taken possession of July 1, 1889, but as the crops of the late owner were still occupying most of the land no very extensive series of fall experiments could be inaugurated, and no report of results can now be expected." Field experiments with cotton seed in various forms and with other fertilizers, and tests of varieties of wheat have been undertaken. "The preparatory work done includes ditching, under-draining (tiles), removing old fences, reclaiming, etc., besides the erection of two buildings, one each for the horticulturist and agriculturist. A barn is yet to be built before experiments can be commenced in the feeding of stock and dairying."

ENTOMOLOGY, J. P. CAMPBELL, PH. D. (pp. 82–89, illustrated).—Accounts of the cotton caterpillar (*Aletia argillacea*), potato sphinx (*Phlegethontius celeus*), and twig girdler (*Oncideres cingulatus*), with suggestions as to remedies.

SOUTHERN DRIFT AND ITS AGRICULTURAL RELATIONS, J. W. SPENCER, PH. D. (pp. 90–94).—A description of the geological formations known as "Southern drift," especially as they are found in Georgia. It is expected that the agricultural relations of these formations will be discussed in a future article.

Illinois Station, Bulletin No. 8, February, 1890 (pp. 75).

FIELD EXPERIMENTS WITH CORN, 1889, T. F. HUNT, B. S. (pp. 214–272).—The experiments here reported in detail are a continuation of those recorded in Bulletin No. 4 of this station, an abstract of which may be found in the EXPERIMENT STATION RECORD, Vol. I, No. 1, pp. 28–33. "These experiments were made on good prairie soil in eastern Illinois, just north of the fortieth parallel of latitude. The year 1888 was an unusually favorable one for the corn crop; 1889 was much less favorable, there being deficient rain-fall in April and May, excessive rain in June, and an average temperature below normal during the summer months."

Experiment No. 1—Corn, testing of varieties (pp. 214–246).—Over sixty varieties, nearly all dent and including many of those used in 1887 and 1888, were tested in 1889 on eighty-nine plats of 2 by 2 or 2 by 10 rods each, 5 acres in all. The results, as in the similar experiment previously reported, are given in detail in tables, with classified descriptions, summaries, general notes, and a meteorological record of the growing season of 1889. Previous experiments are also taken into account in comparing the different varieties. Attention is called to the desirability of making the tests of varieties on duplicate plats.

It was shown that there was a difference in 1888 of over 9 bushels per acre between the two duplicate plats of Leaming on tract *a* and of 2½ bushels on tract *b*. The difference between two plats of Burr's White on tract *a* was nearly 6 bushels, and on tract *c* nearly 7 bushels per acre. In 1889 Leaming and Burr's White were again selected for a duplicate test. As in 1888, the plats of each tract were more than usually uniform to all appearance, and care was taken to have the conditions as nearly alike as possible. With Leaming the differences ran on tract *a* from less than 1 bushel to 12 bushels; on tract *b* from about 2 to over 5 bushels. With Burr's White on tract *a* the difference was 12 bushels, but on tract *b* 27 bushels. This last is unusual, and was due to the number rather than the size of the ears produced. Differences of 5 to 10 bushels per acre may arise from uncontrollable variations in conditions, while greater variations may occur from such sources. In the averages of the two varieties there was a difference of about 18½ bushels in favor of tract *b*; in 1888 there was a difference of 6¼ bushels in favor of the same tract.

For 1888 the varieties were divided into *early maturing*, which ripened that season in one hundred and twenty-five or less days from date of planting; *medium maturing*, which ripened in from one hundred and twenty-five to one hundred and thirty-five days; *late maturing*, which ripened in from one hundred and thirty-five to one hun-

dred and forty-five days; and *non-maturing.* This season the time of ripening for each class was prolonged about ten days.

There was considerable difference in the height of stalks between the seasons of 1888 and 1889. The average height on eighty-two plats in 1888 was 11.2 feet; in 1889, 9.7 feet. Similar differences were observed in the height of the ears on the stalk.

In 1888, the average per cent of water in the shelled corn when husked was, in the early maturing varieties, approximately 18 per cent; medium maturing, 22; late maturing, 27; non-maturing, 36. In 1889 the average per cent was 17, 24, 29, and 38, respectively. The increase in the per cent of water with the later maturing is very marked. The difference in the loss of weight is more than is usually recognized.

To make a bushel of thoroughly air-dry corn—that is, shelled corn containing 11 per cent of water—it took, when the corn was husked, October 20 to November 13, 72 pounds of ear corn in the early maturing, 80 pounds in the medium maturing, and 89 in the late maturing. As most of the corn produced in central Illinois this season was late, 80 pounds evidently would not have been sufficient to produce a bushel of air-dry corn.

On eighteen plats of tract *a* the same varieties of corn have been grown three years successively. The average yield per acre when the corn was husked in 1887 was 32 bushels; in 1888, 94; in 1889, 82. The yield of air-dry corn for the three years was 29, 83, and 66 bushels respectively. The largest yield of air-dry corn in 1887 was 36½ bushels, from Murdock; in 1888 and 1889, from Leaming, 93 and 79 bushels, respectively. The per cent of water in the shelled corn of the 18 varieties in 1887 was 18.35; in 1888, 21.39; in 1889, 28.27. As the corn was husked at about the same time each season, these figures give a good idea of the difference in the maturity of the corn in the respective seasons.

While no one of the varieties tested stands far above the average of the better varieties of its class, doubtless a large number of the varieties are better than the average raised by the farmers of the State, and might be introduced on their farms with profit. Not to exclude other meritorious varieties, the following medium maturing dent varieties may be safely recommended for general culture in central Illinois: Yellow—Leaming, Clark's Iroquois, Legal Tender, Riley's Favorite, Fisk. White—Champion White Pearl or Burr's White, Gourd-Seed, Clark's Premium 110-Day. The following, which are desirable early maturing varieties in this latitude, may be recommended for general culture in northern Illinois: Yellow—Murdock, Edmonds or Kane County Pride, Grange Favorite, King of the Earliest (for very early). White—Wisconsin White Dent, Champion of the North.

The following, which are almost too late for this latitude, would probably be desirable farther south: Yellow—Improved Orange Pride, Steward's Improved Yellow, Swengel. White—Helms's Improved, Parrish.

Experiment No. 3—*Corn, time of planting* (pp. 247–249).—This is reported in substantially the same manner as was the similar experiment of the previous year. There were in 1888 seven, and in 1889 eight plantings at intervals of a week. In 1888 the first was April 22, the last June 13.

The results of two seasons' experiments indicate that the yield of corn is not appreciably affected by a variation of five weeks, prior to June 1, in the time of planting. Some differences occur which seem to be due to certain variable conditions of weather rather than to the time of planting. Sometimes the later plantings may be properly cultivated with less labor than the early plantings.

Experiment No. 4—*Corn, depth of planting* (pp. 249, 250).—"May 4, 1888, six rows, each 8 rods in length, were planted with corn at depths varying from 1 to 6 inches. May 6, 1889, six rows were planted in the

same manner, and an extra row was planted on each side, so that all the rows under test might be equally surrounded by corn. * * * There were thirty-six hills in a row, and hills and rows were 3 feet 8 inches apart. Four kernels of Burr's White were planted in each hill." The results are reported as in the previous year and compared with those for 1888.

In 1888 the largest yield was from the row planted 1 inch deep; in 1889, from the row planted 6 inches deep. In 1888 the decidedly smallest yield was from the row planted 6 inches deep, while in 1889 it was from the row planted 3 inches deep. In 1888 the latter depth gave the next to the largest yield. In 1888 the smaller yield was due to the smaller number of ears produced; in 1889 it was due both to the smaller number of ears and to their smaller size.

In neither year was there any direct relation between the depth of planting and the yield obtained.

One fact referred to under "Experiment No. 54—Corn, Root Growth," is worthy of mention here. It was found upon examination that at whatever depth planted, 1, 3, or 5 inches, the crown roots start to grow usually at between 1 to 2 inches deep. No roots start at a lower depth, except those growing directly at the seed, and these die after the crown roots are established. With this soil and its last year's conditions, it seemed that nature required that the roots which were to support the plant should start to grow within 2 inches of the surface. The reason for deeper planting, except to reach moisture sufficient to sprout the corn is, therefore, not apparent, and some disadvantages are manifest. Of course the corn-raiser understands that practically it is often necessary on uneven land to plant deep lest some of the corn may be left uncovered.

Experiment No. 5—Corn, thickness of planting (pp. 250-254.—"This experiment was conducted to determine not only the best thickness at which to plant corn, but also the best manner of distributing the corn at a given thickness; whether, for instance, to plant three kernels every 42 inches or one kernel every 14 inches. The plats were planted at six different degrees of thickness, as follows: at the rate of 45,520, 23,760, 15,840, 11,880, 9,504, and 5,940 kernels per acre." Results are reported as in 1888, and compared with those of that year.

Number of stalks.—In 1888, with the same rate of thickness, there were somewhat more stalks harvested for every one hundred kernels planted, where one kernel was planted, than where two, three, or four kernels were planted to a hill; but in 1889 there was substantially no difference in the ratio of stalks harvested to kernels planted, whether one, two, three, or four kernels were planted in a hill.

Weight of stalks and ears.—In both seasons there was a nearly constant increase from the thickest to the thinnest plantings in the weight of one hundred stalks of stover and of one hundred ears, the ears increasing in weight faster than the stalks. The ears were much heavier in the intermediate plantings than in the thickest plantings, but they were not much heavier in the thinnest plantings than in the intermediate plantings, while the increase in weight of stalks was fairly uniform from the thickest to the thinnest.

The development of the plant seems to have depended mostly upon the thickness of planting and but little upon the method of distribution.

The differences in the size of the ears due to the different numbers of kernels in a hill were so slight in both seasons as to be in all probability "within the limits of experimental variation."

Number of ears.—The results of the two years' experiments indicate in general that while the number of ears is increased by thicker planting the proportion of barren stalks and nubbins is also increased.

Yield.—In the experiments for 1888 and 1889 planting at the rate of one kernel every 6 inches gave better results than planting at the rate of one kernel every 3 inches, if the crop was grown for fodder purposes. Planting at the rate of one kernel every 9 inches or one kernel every 12 inches gave better results, if kernel was the main object, than thicker or thinner planting.

Neither for fodder purposes nor for the production of corn merely do these experiments show any material advantage in planting in drills over planting in hills, and this where the cultivation was such as to keep the land equally free of weeds, whatever the method of planting. Taken as a whole, there was very little difference in the results, whatever the methods of distribution of the seed, so long as the rate of seeding was the same.

Experiments 8, 9, *and* 10—*Frequency and depth of cultivation and root pruning of corn* (pp. 254–263).—These are practically one experiment with three sets of conditions. In No. 8, in which the effects of frequency of cultivation are tested, the comparison is between cultivating four times (ordinary cultivation), cultivating five times (ordinary cultivation and once after tasseling), and cultivating fourteen times. In No. 9 the effects of deep and shallow cultivation are compared. In No. 10 the effects of root pruning are observed. As regards frequency and depth of cultivation the results in 1889 were substantially like those in 1888, and indicate that "in this soil [which is very fertile] very good crops of corn may be raised with no stirring of the soil after the corn is planted, if the weeds are thoroughly removed." In the root pruning the object was—

To cut the corn roots at the distance from the hill and to the depth which an ordinary so-called deep cultivator would break them, but without disturbing the soil, so that it might be determined whether such mutilation of the roots by the cultivator, without reference to the stirring of the soil, was harmful.

With root pruning 3 inches deep in 1888, by which only a small portion of the roots were severed, the yield was uniformly but not largely in favor of the unpruned corn.

This season, with the pruning 4 inches deep, the average difference in favor of the unpruned portion was 13.6 bushels. The least difference in any plat, that with frequent, shallow cultivation, was 10 bushels, while the greatest difference in any plat, the one that had no cultivation, was nearly 17.4 bushels. The greatest decrease in yield from root pruning was about one fifth, the least about one eighth, and the average about one sixth. There can be no doubt that this decrease in yield was directly due to cutting the roots.

Experiment No. 54—*Corn, root growth* (pp. 263–267).—"The particular object of inquiry in this experiment was to ascertain the number of the roots of corn and their depth at the points where they are likely to be disturbed by cultivation, and what proportion of all the roots was likely to be so injured." The results of the examination of seven plants in accordance with the plan followed in previous experiments reported

in Bulletin No. 4 are recorded in notes and a table. It was found that—

Rather more than three fourths of the roots would not have been broken by root pruning or cultivating 3 inches deep; nearly two thirds would have been broken at 4 inches deep. Over one third were 4 inches deep at 6 inches from their base.

Another point brought out by these examinations was that the roots (except the seminal ones, those at the seed, which afterwards die), start usually at from 1 to 2 inches from the surface without reference to the depth at which the seed has been planted. In case the seed is planted deeper than this, the stem is simply elongated between the first or seminal whorl and the second or first nodal whorl. The stem between these points is usually about 1.16 inches in diameter, while above the second whorl the stem is oval, and in plants 15 inches high is about half an inch in diameter.

Experiments Nos. 23, 11, and 24—Corn, effect of fertilizers.—The effects of the use of the common commercial fertilizers and stable manure on corn planted continuously and in rotation with other crops for fourteen years, and on corn for 1888 and 1889 are reported. "The conditions of soil, climate, and culture under which these trials were made were not very different from those under which the bulk of this great crop is raised in the United States." Of course, the results obtained in the Mississippi and Missouri Valleys do not apply to the Atlantic and Southern States, where the soil has been reduced by longer cultivation, and the same may be said of many regions in the eastern part of the Mississippi and the Ohio Valleys.

Nothing can be more conclusive than that in the trials made during the past two seasons, no practical benefit was obtained from the use of commercial fertilizers when applied to corn; and, moreover, but very little effect of any kind.

The increased yields from the use of stable manure, taken as a whole, probably repaid the cost of application and left some profit. Clearly the value of stable manure was not equal to the estimates often made, based upon the cost of commercial fertilizers. It should be recognized that the overwhelming testimony derived from experiments so far conducted is that for those States which raise one half or more of the corn of the United States the application of commercial fertilizers for the production of corn is not generally profitable at the present time; and that to base the value of stable manure for those States on the price of the constituents of commercial fertilizers is misleading.

A summary of the experiments with corn at this station, prepared by G. E. Morrow, M. A., is appended to this article (pp. 272–274). Among the conclusions stated are the following:

There are many good varieties of Indian corn for this latitude. No one variety tested was noticeably superior to all others.

Such phrases as "ninety-day" or "one-hundred-day" corn are misleading, if meant to teach that ordinary field corn will fully mature in average seasons in this latitude in the number of days named. The early maturing varieties required one hundred and twenty-five days or more to mature fully.

The medium maturing varieties, or those maturing about September 25, gave larger yields of well dried corn than either earlier or later varieties.

Thoroughly air-dried corn contains about 11 per cent of water in the shelled grain. The loss in weight after husking is greater than is generally recognized. It may be from 10 to 20 per cent. Eighty pounds of ear corn, as husked, of the medium maturing varieties would not make more than a bushel of air-dry corn.

Barrenness of the stalk seems to depend much more on the conditions under which the crop is grown, as thickness of planting and the season, than on the variety.

The date of planting within the limits ordinarily fixed for corn planting in this latitude had little influence on the yield of a medium maturing variety.

Depth of planting did not materially affect the yield either in 1888 or 1889. In the latter year the roots which supported the plant during the most of its growth usually started within 2 inches of the surface, whatever the depth of planting. Unless the soil near the surface has not sufficient moisture, there seems to be no good reason for planting corn in this region more than about 3 inches deep. Drill-planting was not found materially better than hill-planting, either for the production of corn or fodder. The quantity of seed planted controlled the yield, rather than planting one or four kernels in a place. For corn alone, planting at the rate of one kernel every 9 or 12 inches gave better results than thicker or thinner planting. For fodder, planting at the rate of one kernel every 6 inches gave better results than planting twice as many kernels.

Stirring or cultivating the soil while the crop is growing was not essential in either 1888 or 1889. Good yields of corn were obtained where there was no cultivation after planting, except to remove the weeds by scraping the surface.

Preventing the growth of weeds was more important than stirring the soil.

Root pruning injured the crop. Stirring the soil to a depth of 4 inches or more will injure many roots of the corn. Comparatively few roo s will be affected if the soil is not stirred more than 2 inches deep.

Shallow-working cultivators gave better results than deep-working ones, but required more care and skill in their use. The deep-working shovel cultivators killed the weeds more thoroughly than the shallow-working ones, but the latter injured the roots less. Usually, frequent cultivation did not repay the extra cost.

Commercial fertilizers failed to increase materially the yield of either corn or fodder in any one of nine trials. The soil apparently had a sufficient supply of plant food that these fertilizers furnish.

Stable manures increased the yield of corn and fodder in most cases, but not always enough in one year to repay certainly the cost. Fair crops were produced on land which had been in corn for fourteen years without manure of any kind. For like soils in Illinois, the estimates often made of the value of either commercial or barnyard fertilizers, based on the price at which the elements of plant food contained by them can be bought, are misleading.

The yield of most varieties, and the average yields of all, in 1888 and 1889, were above the average reached by good farmers in field culture. Probably the chief reasons for this result were that the varieties were better than the average; that more than usual care was taken to secure a good seed bed and to plant well, thus securing a good and uniform stand; and that the cultivation was more careful than an average field culture.

GARDEN EXPERIMENTS WITH SWEET-CORN, 1889, T. J. BURRILL, PH. D., AND G. W. MCCLUER, B. S. (pp. 274-287).—

Experiment No. 49—Sweet-corn, testing varieties.—The experiment was in general like that reported in Bulletin No. 4 of this station, an abstract of which may be found in Experiment Station Record Vol. I, No. 1, p. 33. Classified descriptions of thirty-three varieties not described in Bulletin No. 4 are given, and tabular records for some eighty varieties tested in 1890. The results of tests of the vitality of seed corn used in the greenhouse and the fields are condensed in the following table:

Table showing the relation of vital power to per cent of live seeds.

No. of varieties in each lot.	Average per cent of live seeds as shown in greenhouse tests.	Per cent of live seeds growing when planted in the field.
32	94 74	75.97
37	83.2	60.8
24	68.78	60 19
17	52.18	55.46

"The conditions in the greenhouse were only fair for the germination of corn, while the conditions in the field were bad," owing to drought followed by heavy rains and cold weather.

Among so many varieties it would be presumptuous to name any one as the best. But for general planting any of the following varieties, mentioned in the order of earliness, may be recommended: early—Cory, Narragansett, Ford's Early, Minnesota, Leet's Early; medium—Crosby, Concord, Stabler's Early, Landreth Sugar, Black Mexican; late—Amber Cream, Ruby, Stowell's Evergreen, Eight-Rowed Triumph, Egyptian, Late Mammoth. The early small-growing varieties do best planted, if in hills, 1½ to 2 feet apart; the medium 2½ feet apart; and the large, late varieties, 3 to 3½ feet apart. * * *

Sweet-corn for seed should be gathered before there has been any extremely cold weather. As soon as gathered, it should be thoroughly dried, and kept dry until planted the following season.

Indiana Station, Bulletin No. 30, February, 1890 (pp. 11).

INFLUENZA, T. D. HINEBAUCH, V. S.—Synonyms: epidemic catarrh, epizootic catarrhal fever, panzootic catarrhal fever, distemper, epizootic. This disease, the bulletin states, has been recognized in its various forms for centuries, and prevails to a greater or lesser extent at all times and at all periods of the year and in all countries where horses are used. It is defined as being essentially a contagious and infectious febrile disease, due to the introduction of a specific micro-organism. The true nature of this organism, however, is as yet little understood.

The disease is asserted to show itself in many forms, of which the catarrhal, where there is only a discharge from the mucous membrane lining the nasal passages, throat, and windpipe, is the most common. Laryngitis (sore throat) and epizootic cellulitis (pink eye) are other forms of influenza. The symptoms of each of these forms are given, as well as directions for treatment.

Observations are also recorded on the development of a case of influenza which occurred in the private practice of the author in Kalamazoo, Mich., June, 1887. In this instance the disease attacked the heart, and a fatal case of heart disease, with extensive pericarditis, resulted. The illustrations exhibit the roughened, abnormal appearances of the diseased organ.

Kentucky Station Bulletin No. 23, February, 1890 (pp. 13).

Experiments with oats (pp. 3–9).—A report on small experiments in the following lines: (1) test of varieties; (2) depth of sowing; (3) methods of sowing; (4) time of sowing; (5) amount of seed per acre. The trials were made on a wet, cold, clayey, blue-grass soil, with hard pan 18 inches to 2 feet below the surface, causing imperfect drainage. The soil was somewhat worn from long cultivation. "At the time of planting 500 pounds of cotton-seed-hull ashes were applied broadcast. The season was unfavorable, being very dry in the early part and very wet in the later part." (1) *Test of varieties.*—Tabulated notes on nineteen varieties. The yields varied from 20.7 bushels to 46.5 bushels per acre. "The best variety tried was White Victoria, followed closely by Haggett's White Siesure, Barley Oats, Welcome, Improved American, and White Schoener. (2) *Depth of sowing.*—Welch oats were sown on three plats at depths of 1, 2, and 3 inches. The largest yield came from the 2-inch depth. (3) *Methods of sowing.*—Drilling, broadcasting with barrowing, and broadcasting with plowing in were compared on six fo tieth-acre plats. The second method gave the largest yields. (4) *Time of sowing.*—The largest yield was from seed sown March 27, the next April 4, the third April 12. Later sowings were failures. (5) *Amount of seed per acre.*—Amounts varying from 1 to 4 bushels were sown with a drill. There was little difference in the yields.

Fertilizer experiments on English blue grass (Festuca pratensis) and timothy (pp. 9–13).—During the season of 1888, 4 acres of decidedly wet, well-worn land were seeded with grasses, 2 acres with English blue-grass (*Festuca pratensis*) and 2 with timothy. In the spring of 1889 a series of seven tenth-acre plats was selected for experiment from each of the two divisions of the field, and to the corresponding plats of both series fertilizers were applied singly as follows: sulphate of potash, 16 pounds; muriate of potash, 16 pounds; nitrate of soda, 16 pounds; sulphate of ammonia, 13 pounds; stable manure, two loads; tobacco stems, 400 pounds. One plat of each series was left unmanured. As appears from the tabulated results, much the largest yields were obtained from the plats to which tobacco stems were applied, the increase of blue-grass being 106, and of timothy 65 per cent above the yield of the unmanured plat of the corresponding series. The effects of the nitrogenous fertilizers, nitrate of soda, and sulphate of ammonia were also decidedly beneficial, while the use of potash does not seem to have been profitable.

It should be observed that the name English blue-grass is used in this article, as in numerous other cases, as a popular name for *Festuca pratensis* (meadow fescue), which should, of course, be distinguished from *Poa compressa*, the real Eng'ish blue-grass.

Kentucky Station, Bulletin No. 24, March, 1890 (pp. 20)

THE BROOM-RAPE OF HEMP AND TOBACCO, H. GARMAN (illustrated).—This contains a popular account of this parasite of hemp and tobacco with suggestions as to its repression. It appears from investigations made by the station that this plant has been in Kentucky at least ten years, but has only recently become severely destructive. Of the fifteen species of the broom-rape family which occur in North America, four are found in Kentucky. These are the broom-rape of hemp and tobacco (*Phelipæa ramosa*), beech-drops (*Epiphegus virginiana*), squaw-root (*Conopholis americana*), and *Aphyllon uniflorum*. The seeds and plant of *Phelipæa ramosa* are described and illustrated, as well as the life history of the plant. The parasite injures hemp and tobacco by feeding on the sap of these plants, thus causing weakness of the stems, and in the case of hemp an imperfect fiber. In some cases 50 per cent of the crop has thus been rendered worthless. In Kentucky thus far this species has been confined almost exclusively to hemp and tobacco, though one observer states that he has seen it on tomato plants. Rotation of crops, burning over infested fields, care in collecting seed for planting, and the use of fertilizers to stimulate growth of crops are suggested as means of avoiding the injuries inflicted by the broom-rape. Gas lime applied to the land in the fall has been found useful in destroying the broom-rape seeds. While hemp or tobacco grown on a rich, loose soil may often escape injury from broom-rape, it should be observed that in the case of infested land the danger is greater to the crop planted on loose soil than to that on a heavy soil. Rolling loose soil with a heavy iron roller may "to some extent do away with one of the conditions which favor injury from broom-rape." Experiments are now in progress at the station to get light on the problems connected with the application of various materials to the soil as preventives of injury by this parasite.

Kentucky Station, Bulletin No. 25, April, 1890 (pp. 8).

STRAWBERRIES.—Tabular record and field notes for twenty-five varieties.

From our observations this year the following new varieties would seem worthy of trial for market: Jessie, Bubach No. 5, Haverland, Warfield's No. 2, Itasca, and perhaps the Crawford, and for a late berry Gandy's Pride. For family use the Jessie, Warfield's No. 2, Itásca, Crawford, and Henderson, and for a late berry Gandy's Pride would be a good selection.

Massachusetts Hatch Station, Bulletin No. 7, January, 1890 (pp. 23).

SMALL FRUITS AND VEGETABLES, S. T. MAYNARD, B. S. (pp. 2–13).—*Raspberries and blackberries* (pp. 3, 4).—A summary of the tests of old and new varieties of these fruits at this station during two or more years is given in tables, which contain data for fifteen varieties of red

raspberries, nine of blackcap raspberries, and sixteen of blackberries Among the varieties which gave good results were, Rancocas, Brandy wine, Cuthbert, Hansel, and Marlboro of the red raspberries; Agawam and Lucretia of the blackberries. "Under good cultivation both the raspberry and blackberry are profitable, and the demand for choice fruit is increasing."

Girdling grape-vines (pp. 4–6).—This contains a report by Dr. Jabez Fisher, of Fitchburg, "the father of grape-growing in Northern Massachusetts," on the experiment made by him at the request of the station to test the effect of girdling the grape-vine, on the time of ripening, and especially on the quality of the fruit, an important question being whether the increase of the fruit is at the expense of quality. Analyses of samples of the grapes produced in this experiment, by Dr. C. A. Goessman, are also reported.

The results of these, as of previous experiments, indicate that when the vine is girdled the fruit ripens so much earlier (about ten days) that many late varieties may be grown in this section which otherwise would not mature before frost; "that a gain of ten days would make a great difference in the price of the fruit; that there is no loss of sugar, and the increased size of the fruit would make it very attractive and more than make up for the softness of the berry. This latter condition can be of little objection, as most of the grapes grown in New England are sold in local markets."

Tomatoes (pp. 6–8).—This contains a table giving the results of tests of forty-six varieties of tomatoes. Those producing the largest number of ripe tomatoes up to October 2, were Little Gem, Red Pear-Shaped, Early King Humbert, Hubbard's Curled, of the red varieties; Green Gage, New White Ample, and Early Pig, of the yellow varieties. Attention is called to the fact that the varieties producing the most double flowers were the most irregular in forming and had comparatively imperfect fruit. Growers of choice fruit and of seed are advised to discard plants having double blossoms.

Eastern vs. Western seed sweet-corn (pp. 8–10).—These experiments were made to test the comparative value of the seed of sweet-corn grown in New England and that grown in the Western States. Sixteen varieties were grown, and the tests were duplicated in each case. The results are given in tables, including the following topics: size of ears and kernels, number and weight of ears, weight, average height of stocks, time of ripening, chemical analysis of kernels selected when just passing out of the milk stage. No very definite conclusions were reached. "In the corn varieties there is a decided increase of sugar in the Eastern-grown over that in the Western, but in the other varieties the results seem to be in favor of the Western-grown seed. Such a test, however, as the above requires several years repetition before we can feel that we have reached conclusive results." Attention is called to the fact that as yet little is known of the influence the pollen of one

variety may have upon the variety fertilized by it, and that this may be an important factor in experiments of this kind where a number of varieties are grown together.

Lettuce (pp. 10, 11).—The results of tests of thirty-eight varieties are given in a table. White Tennis Ball excelled in earliness; Black Seeded Simpson, Oak Leaf, Sugar Loaf, and Versailles Cabbage in lasting qualities; and Black Seeded Simpson and Sugar Loaf in size.

Potatoes (pp. 11, 12).—A table gives the results of tests of twenty-four varieties. The seed potatoes were cut to single eyes and planted one piece in each hill. The greatest weight of crop was produced by Pearl of Savoy, Early Maine, New Queen, Early Puritan, and Hampshire County.

Combined fungicides and insecticides in potato growing (pp. 12, 13).—Paris green and plaster were applied on one plat, and a solution of Paris green and sulphate of copper on another. "In both plats the potato beetle larvæ were effectually destroyed. In plat No. 2 the growth of foliage was slightly checked, but the blight did not strike it quite as soon as that in plat No. 1. In plat No. 1, where no sulphate of copper was used, we found seventy-four rotten tubers, while in plat No. 2 only sixteen rotten ones were found. This result may be accounted for perhaps on the theory that the spores or germs of the disease were destroyed when they reached the ground where the copper solution had been retained by the soil."

Protection of fruit-trees from mice, rabbits, and woodchucks (p. 13).—The experience of several years has indicated that a mixture of lime, cement, and Paris green in skim-milk or water is efficient for this purpose. The mixture made with skim-milk adheres better than that made with water, and when water is used Portland cement adheres more firmly than Roslyndale. The amount of Paris green used was one tablespoonful to each two gallon pailful of paint, mixed so as to easily apply with a paint brush.

GENERAL RESULTS OF A TRIAL OF A FEW JAPANESE CROPS, W. P. BROOKS, B. S. (pp. 14–17).—The seeds were collected by Dr. Brooks in Japan. The varieties tested were three of millet, *Panicum crus-coroi* (Jap. *Hiye*), *Setaria italica* or *Panicum italicum*, red-headed variety (Jap. *Mochi awa*), and *Setaria italica* or *Panicum italicum* (Jap. *Awa*); and four varieties of beans, Soja bean, medium early, *Glycine hispida* (Jap. *Daidzu*), Soja bean No. 2, very early, *Glycine hispida* (Jap. *Kurakake mame*), red beans, *Phaseolus radiatus*, and white beans, *Phaseolus radiatus*. The results of these preliminary tests were, on the whole, encouraging.

GYPSY MOTH (OCNERIA DISPAR), C. H. FERNALD, PH. D. (pp. 18–23).—This is a reprint of a special bulletin of this station, issued in November, 1889, an abstract of which is given in EXPERIMENT STATION RECORD, Vol. I, p. 225.

Massachusetts Hatch Station, Meteorological Bulletins Nos. 13, 14, and 15 (pp. 4 each).

These include a daily and monthly summary of observations for January, February, and March, 1890, made at the meteorological observatory of the station, in charge of C. D. Warner.

Michigan Station, Bulletin No. 56, February, 1890 (pp. 4).

RIB-GRASS OR NARROW-LEAVED PLANTAIN (PLANTAGO LANCEOLATA), IN FIELDS OF CLOVER, W. J. BEAL, PH. D.—A brief, popular account of this weed, which has recently been introduced in several localities in Michigan. A sample of the seeds of this species is sent with the bulletin.

Missouri Station, Bulletin No. 10, April, 1890 (pp. 16).

REPORT OF DEPARTMENT OF HORTICULTURE, J. W. CLARK.—*Analyses of apples* (pp. 3–5).—A record of analyses of Ben Davis apples, including unripe apples (July 9) and large and small ripe apples (October 23). The analyses indicate that a large proportion of the mineral matter of the fruit is stored up during the early stages of its growth. It was calculated that "from an acre of land set with apples 30 feet apart and yielding 10 bushels of fruit to the tree the unripe fruit would take 6 pounds of phosphoric acid and 37½ pounds of potash, and the large ripe apples 7 pounds of phosphoric acid and 43 pounds of potash." From this the importance of thinning fruit and the relatively small cost of growing large and perfect apples are argued. The use of phosphoric acid and potash in ground bone, wood ashes, etc., as fertilizers, is also urged.

Bordeaux mixture for grape rot (pp. 5, 6).—A brief account of an experiment in the use of the Bordeaux mixture for the rot on Concord, Elvia, Goethe, and other varieties of grapes. The advantage of the frequent application of the fungicide in a wet season was shown in this case.

Test of varieties of small fruits and potatoes (pp. 6–13).—A tabular record and notes for 43 varieties of strawberries, 14 of raspberries, 7 of blackberries, and 130 of potatoes.

List of fruits on the horticultural grounds of the College and Station (pp. 14–16).—This includes 82 varieties of apples, 39 of pears, 10 of peaches, 19 of plums, 11 of cherries, 7 of apricots, 4 of nectarines, 41 of grapes, 56 of strawberries, 15 of raspberries, 11 of blackberries, and 2 of dewberries.

North Carolina Station, Bulletin No. 69, February 26, 1890 (pp. 16).

FERTILIZER ANALYSES AND THE FERTILIZER CONTROL FOR 1890, H. B. BATTLE, PH. D.—Under the fertilizer law of North Carolina

samples for analyses are not drawn until the fertilizers are in the hands of local agents. Owing to the lateness of shipments into the State during the present season this plan has delayed somewhat the publication of analyses, but is still considered preferable to accepting samples sent by manufacturers. The bulletin contains analyses and valuations of thirty-seven fertilizers and a revised list of all brands licensed for sale in the State. Former valuations of the station have aimed to represent approximately the cash cost at retail of the mixed fertilizers at the seaboard; but for the present season the "commercial value" of a fertilizer is reckoned from the actual retail cash price of the *ingredients* in bags at the seaboard, including no expenses of mixing or handling. For interior points freights must be added. By this system the valuation for available phosphoric acid and potash for the season of 1890 will be 5 cents each, and for ammonia 13 cents per pound. This system of valuation has been adopted by North Carolina, Virginia, and South Carolina.

Ohio Station, Bulletin Vol. III, No. 1 (second series), January, 1890 (pp. 15).

EXPERIMENTS WITH POTATOES, W. J. GREEN (pp. 5–14).—

Tests of varieties (pp. 5–11).—A tabular record is given for 48 varieties grown at the station in 1889, for 13 varieties grown by W. Dresbach, of Pickaway County, and for 8 varieties grown by B. H. Brown, of Butler County, F. Patton, of Harrison County, and M. E. Eidmiller, of Miami County. The results vary sufficiently to indicate that general conclusions can not be safely drawn from tests made in a single locality. The following summary is taken from the bulletin:

From the results of eight trials in 1888 and five in 1889, thirteen in all, and made in eleven different localities, the following conclusions may be drawn:

The most productive of the early varieties are Oxford, Puritan Early, and Crown Jewel. Next in order stand Nott and Lee Favorite. Of the medium and late sorts Empire State, Summit, Seneca Beauty, White Elephant, and Delaware rank the highest of those that are fully tested. Including early, medium, and late varieties, not fully tested, those that are the most promising are Queen (New Queen), Rural New Yorker, Superior (Burpee's Superior), and Minnesota Early. Early Ohio, Ohio Junior, and Stray Beauty rank as the earliest, but are unproductive. Albino and Chas. Downing seem to be less reliable than formerly, probably owing to susceptibility to blight. Northern Spy and Monroe Prize are inferior in appearance, hence not valuable for market. The former is unproductive, and it is not probable that the latter will rank very high in this respect. Oxford, Seneca Beauty, and Delaware show comparatively little variation on different kinds of soil.

Field experiments with fertilizers (pp. 11–13).—During 1888 and 1889 acid phosphate (dissolved S. C. rock), Thomas slag, superphosphate (dissolved bone-black), nitrate of soda, and sulphate of potash singly and the last three in combination, have been compared with farm manure and no manure as fertilizers for potatoes. In both years the injury to the crop caused by blight was so great that the results were unsatisfactory, except so far as they confirm the results of other tests. The

following is a summary of the results obtained with fertilizers on potatoes for the entire period that this work has been carried on by the station. The tests have been made on several different classes of soil and in two different localities. As indicated in the bulletin, these results agree substantially with those reported for potatoes in a bulletin of this Department on the Results of Field Experiments with Various Fertilizers, published in 1883.

(1) Sulphate of potash and muriate of potash have in some instances increased the yield, but in no case sufficiently to make their use profitable.

(2) Nitrate of soda and sulphate of ammonia have in a few cases given a slight increase in yield, but not to a profitable degree.

In seasons when blight has been the most severe these substances, especially the former, have apparently exerted an injurious effect.

(3) Superphosphate (dissolved bone-black), acid phosphate, and Thomas slag have in nearly all cases increased the yield. Thomas slag is the cheapest form in which phosphoric acid can be obtained, and the trials indicate that its use on potatoes is likely to be attended with greater profit than that of either of the other substances named.

(4) A mixture of sulphate of potash, superphosphate, and nitrate of soda has usually given better results than superphosphate alone, but not always.

(5) Barn-yard manure has increased the yield, but not always the total marketable product, because of the usual prevalence of scab where this fertilizer is used.

(6) In no case has the potato crop been benefited, to a profitable degree, by the application of fertilizers of any kind on soil that was already in a high state of fertility.

(7) On soil that had been worn by previous cropping, phosphatic fertilizers, the so-called complete chemical fertilizers, and barn-yard manure have in nearly all cases given profitable returns.

(8) The rational conclusion is that since the potato requires a soil that is in a high state of fertility, and since the direct application of fertilizers to the crop is attended with considerable uncertainty, the most feasible method is to bring the soil up to the proper condition by enriching the land for previous crops. The best crop of potatoes that has been grown at the station succeeded a crop of cabbages that had been heavily manured. The most approved practice is to grow potatoes after clover, fertilizing both the clover and preceding crop.

Cutting of seed (pp. 13, 14).—The experiments with different methods of cutting seed potatoes, which have been carried on each season since the organization of the station, were continued in 1889 on a larger scale than formerly and with a greater number of varieties, the special object being to test the validity of conclusions drawn from former experiments.

There is sufficient uniformity in the results of different seasons to warrant the following conclusions:

(1) Other conditions being the same, the larger the cutting the greater the total product, *i. e.* the total product varies in about the same ratio as the size of the cutting.

(2) The marketable product also increases as the size of the cutting is increased, but does not follow the same ratio as the total product, the rate of gain being less.

(3) The increase is found in both the large and small potatoes, the greater portion being in the latter.

(4) A crop grown from whole potatoes matures at an earlier date than from small cuttings.

(5) Small cuttings require soil that is more highly enriched and thoroughly prepared than large cuttings and whole potatoes, in order to secure a good stand and to produce a profitable crop.

(6) The question of relative profit, as between the use of small cuttings and whole potatoes, depends upon the cost of seed potatoes, the date at which the crop is to be harvested and sold, and the condition of the soil at planting time.

(7) In ordinary practice it will usually be found that neither extreme, as to quantity of seed used, will be found to be profitable. The safest plan is to use large, well-matured, healthy potatoes, and cut to two and three eyes.

Pennsylvania Station, Bulletin No. 10, January, 1890 (pp. 31).

SHOULD FARMERS RAISE THEIR OWN VEGETABLE SEEDS? G. C. BUTZ, M. S. (pp. 3–8).—In Bulletin No. 4 of this station were published the results of tests of vegetable seeds from various seedsmen, which indicated that such seeds, as found in the country stores of Pennsylvania, are, as a rule, pure and good. In 1889 the station instituted trials to get light on the following question: "Are seeds which have matured under high cultivation (as on our best seed farms) better for our less enriched farm soils than seeds which have matured in poorer soil?"

This is a question of considerable importance, and one to which attention is frequently directed by the agricultural journals. * * * Cultivated vegetables, as a rule, are further removed from their original or "wild" forms by the natural development due to high culture than are the cereals and other ordinary farm crops. Therefore, the conditions of soil and cultivation under which vegetables are grown have much to do in fixing the value of the seeds maturing on these plants. We have only to compare the wild carrot of our fields with the cultivated form of the garden to note the change which has been wrought by cultivation. The former is an annual, with a slender root, toughened by much woody fiber; the latter is a biennial, with a fleshy, tender root. It has often been observed, too, that reversions are common among carrots growing in poor soil. These and similar facts concerning other vegetables should not be ignored in considering this question. * * *

The conditions at the station were very favorable to the work, and last year seeds were gathered from the best of those vegetables that seeded. The ground in which they grew is not a rich garden soil, but only an ordinary farm soil. These seeds were planted this year along with seeds of the same varieties from well-known seed houses.

The results as regards earliness, productiveness, vigor, and quality of the products are recorded in tables in which comparative data are given for the seeds grown at the station and those purchased from seedsman. Nine varieties of beans, 10 of lettuce, 8 of peas, 11 of radishes, and 6 of tomatoes were included in the tests, which will be continued.

The results thus far obtained may be summarized as follows: (1) The station seeds were, as a rule, heavier than the purchased seeds, but the weight was no indication of their germinative value. (2) The greater yields, with but few exceptions, were obtained from purchased seeds. (3) Lettuce from purchased seed produced heads that did not "shoot up" to flower as early as the plants from station seed. (4) Radishes from purchased seeds were larger, more tender, and more uniform than those from station seeds. (5) On the whole the results are strongly in favor of seeds from good soil, however rich that may be.

NOTES ON NEW VARIETIES OF VEGETABLES, G. C. BUTZ, M. S. (pp. 9-15).—This includes notes on 8 varieties of beans, 8 of cabbages, 5 of cauliflowers, 2 of sweet-corn, 3 of celery, 3 of lettuce, 15 of peas, 4 of radishes, and 10 of tomatoes.

TESTS OF VARIETIES, 1889, W. H. CALDWELL, B. S. (pp. 16-30).—A report on tests of varieties of wheat, oats, barley, and potatoes.

Wheat (pp. 16-19).—Eleven varieties were tested in 1890. From general characteristics as well as yield the following varieties, which have been grown several seasons at the station, "may be ranked in this locality (on a retentive lime-magnesia clay soil, with a compact subsoil) in the following order: Dietz' Longberry Red, Fulcaster, Fultz or German Emperor, McGhee's White, Raub's Black Prolific, Sibley's New Golden, Extra Oakley.

Oats (pp. 19-21).—Notes on eleven varieties. Improved American and Wide-Awake gave the best general results.

Barley (pp. 21, 22).—Four varieties were tested. The Mansbury proved the earliest and most desirable and gave the largest total yield of grain and straw.

Potatoes (pp. 22-30).—A tabular record and notes for twenty-six varieties grown from single-eye cuttings. The following are the conclusions stated:

As the result of the season's work, taking yield and general character of tubers in consideration, the varieties may be recommended, for this section and where climatic conditions and soil are similar, as follows:

White Victor (with exception of extreme lateness), Early Puritan, College White, Thorburn, Burpee's Superior, Hampden Beauty, Monroe County Prize, Polaris, Vanguard, and Dakota Red.

This order of merit is the same whether based upon the farmers' general comparison (yield and general character of crop) or upon the more accurate and better mode, that of the yield of valuable food material (dry matter) per acre.

The experience of the last two seasons warrants us in recommending the following as a guide for farmers in selecting a variety of potatoes for cultivation:

Choose a variety from the more thoroughly tested and proven kinds; if possible one that has been successfully cultivated in your immediate vicinity or in a locality that has similar soil and climatic conditions.

Obtain seed from a reliable grower direct. If it is impossible to do so, then purchase of a responsible seed dealer.

A light-colored, good-sized, regular-shaped tuber with smooth skin and shallow or medium deep eyes is to be desired.

Wisconsin Station, Bulletin No. 22, January, 1890 (pp. 12).

REPORT ON OATS AND BARLEY FOR 1889, L. H. ADAMS (pp. 3-6).—Tests were made with twenty-seven varieties of oats and seven of barley on well-drained and level clay loam. The comparative yields are stated in a table and illustrated by a diagram. The height of straw, date of harvesting, yield of straw per acre, weight of kernels and hulls, per cent of hull to whole grain, and the condition of the straw after a storm, July 2, for each variety are recorded in a table. "Trials for a

series of years have proven the White Schoenen, Swedish, Improved White Russian, and Huebner's Holland oats to be uniformly productive, as well as meritorious in several other particulars. The station, therefore, recommends these varieties in the order named. * * * Among the barleys the Manshury is to be preferred above all others."

It is urged that in judging of varieties of oats, not only the yield of grain, but also the strength of straw and the thickness of the hull should be taken into account, and that as much time and thought should be bestowed on the selection of pure seed for oats as is given to the choosing of seed corn. "On farms where both grain and straw are fed out, it is recommended that the plan be tried of cutting when the grain is ripening, but early enough to make hay of the crop." If this is found to work well it would doubtless save time and money now expended in threshing the grain.

REPORT ON POTATOES FOR 1889, E. S. GOFF (pp. 7–12).—*Test of varieties.*—This included one hundred and eighteen named sorts and four seedlings, and was made "on a clover sod on rather light loam, in a moderate condition of fertility, but very well prepared. Pieces containing two eyes each were planted 19 inches apart in drills 38 inches apart." The season was unusually dry. The comparative yields of fifty-two varieties are stated in a table and illustrated by a diagram, and the table quality of the ten most productive varieties, as indicated by their specific gravity, is recorded in the same way. The date of ripening is also given for the fifty-two varieties. More complete details of the experiment will be given in the next annual report of the station. Of the one hundred and twenty-two varieties tested in 1889, the ten following (in the order named) were the most productive that season: "Seedling from C. E. Angell, Rose Beauty, Monarch, Duplex, Late Beauty of Hebron, Mullaly, Alexander's Prolific, Seneca Red Jacket, White Beauty of Hebron, and Wisconsin Beauty."

For their table quality these varieties rank in the following order: "Alexander's Prolific, White Beauty of Hebron, Late Beauty of Hebron, Duplex, Monarch, Wisconsin Beauty, Seneca Red Jacket, Rose Beauty, Mullaly, Seedling from C. E. Angell."

Methods of planting—Amount of seed.—The comparative yields from planting whole potatoes (large, medium, and small), halves, two eyes, and single eyes, are stated in a table and illustrated by a diagram. The seed used was purchased for Beauty of Hebron, but proved to be considerably mixed. "The total yield was directly in proportion to the bulk of seed planted, but in merchantable yield, the two-eye cuttings slightly surpassed the halves and whole tubers. In a test made at this station in 1883 * whole tubers yielded best, 'common' cuts second, and single eyes poorest; and in another made in 1887 † large potatoes, with all the eyes cut out but one, yielded much better than two-eye cuttings,

* Wisconsin Station, Report for 1883, p. 24.
† Wisconsin Station, Bulletin No. 13.

or small whole tubers." In another experiment, the details of which are not recorded, two large, whole potatoes to the hill yielded more merchantable tubers than did one. It is therefore thought probable that the smaller merchantable yield of the halves and whole potatoes in 1889 was due to the dryness of the season. The tests made at this station, as a whole, favor heavy rather than light seeding.

Cutting off the "seed ends" of potatoes.—The cutting off of the cluster of eyes at the "seed end" of the potato before planting is sometimes advocated, on the assumption that the tendency to produce small tubers is thus reduced. An experiment made at this station the past season failed to justify this practice. The yield of merchantable potatoes was considerably larger, and that of small potatoes less when medium-sized potatoes were planted whole than when three fourths of an inch was cut from the "seed end" before planting. These results agree with those obtained at the New York State Station in 1888.* "An experiment in dipping the cut surface of seed potatoes in plaster before planting failed to show any advantage for this treatment."

* New York State Station, Report for 1888, p. 186.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

SECTION OF VEGETABLE PATHOLOGY.

BULLETIN No. 11.

REPORT OF EXPERIMENTS MADE IN 1889 IN THE TREATMENT OF THE FUNGOUS DISEASES OF PLANTS (pp. 119, illustrated).—This embraces the reports of special agents of the section who conducted experiments in New Jersey, Virginia, South Carolina, Mississippi, Missouri, Michigan and Wisconsin. The diseases treated were: (1) of the apple, scab (***Fusicladium dendriticum*** [Wallr.], Fuckl.), rust (*Ræstelia pirata*, Thax.), bitter rot (*Glœosporium versicolor*, Berk.); of the grape, powdery mildew (*Podosphæra oxyacanthæ*, DBy.), downy mildew (*Peronospora viticola*, DBy.), leaf blight (*Cercospora viticola*, Thüm.), anthracnose (*Glœosporium ampelinum*, Sacc.), black rot (*Læstadia Bidwellii* [Sacc.], V. & R.), powdery mildew (*Uncinula ampelopsidis*, Pk.); (2) of the pear, leaf blight (*Entomosporium maculatum*, Lév.); of the quince, leaf blight (*Entomosporium maculatum*, Lév.), rust, (*Ræstelia aurantiaca*, Pk.), blight, (*Micrococcus amylovorus*, Burrill); of the peach, rust (*Puccinia pruni-spinosæ*, Pers.); of the plum, rust (*Puccinia pruni-spinosæ*, Pers.); of the strawberry, leaf blight (*Sphærella fragariæ*, Tul.); of the blackberry, rust (*Cæoma nitens*, Schw.), leaf blight (*Septoria rubi*, Westd.); of the potato, rot (*Phytophthora infestans*, DBy.); of the tomato, rot (*Macrosporium solani*, Rav., and *Fusarium solani*, Mart.), blight (*Cladosporium fulvum*, Cke.); of the melon, blight (*Septoria*). The bulletin also contains a summary of reports from a number of grape growers in different parts of the country who treated their vines for mildew, anthracnose, and rot; abstracts of reports of experiments in the treatment of black rot and mildew in France and Italy in 1889; and a short review of a recent paper by B. Fallot, of the School of Agriculture at Montpellier, France, on the amount of copper in wines made from grapes treated with copper compounds.

QUARTERLY BULLETIN, MARCH, 1890.

JOURNAL OF MYCOLOGY, VOL. VI, No. 1 (pp. 44).—This contains a translation of a paper by Dr. Oskar Brefeld on recent investigations of smut fungi and smut diseases; articles on the effects of blue vitriol and copperas on the vitality of seeds of corn and wheat; treatment of black rot, brown rot, downy mildew, powdery mildew, anthracnose of the

grape, scab and leaf blight of the pear, apple powdery mildew, peach yellows, mildews upon plants under glass, cranberry scald, cranberry gall fungus, and apple scab; the copper salts as fungicides; notes on fungicides and a new spraying pump; prevention of smut in oats and other cereals; observations on the development of some fenestrate sporidia; new species of fungi; reviews of recent literature, and the first part of an index to current North American mycological literature.

BUREAU OF ANIMAL INDUSTRY.

SPECIAL BULLETIN.

PROCEEDINGS OF AN INTERSTATE CONVENTION OF CATTLEMEN HELD AT FORT WORTH, TEXAS, MARCH 11-13, 1890 (pp. 102).—This convention was attended by about four hundred delegates, appointed for the most part by the governors of Kansas, Missouri, Illinois, Arizona, New Mexico, Texas, Colorado, Arkansas, Nebraska, Indian Territory, and Wyoming, besides a large number of other cattlemen from the States and Territories named. H. B. Stoddard, of Texas, was chosen president, and L. E. Finch, of Kansas, secretary. A carefully considered address by Col. W. L. Black, of Fort McKavett, Texas, advocated State bureaus of information that might lead up to a cattle growers' exchange. The object of these bureaus would be to make a correct record of the available supply and probable demand for live stock, according to age and sex, in order that an intelligent opinion might be formed in advance as to the value of animals grown on the farms. Our live stock industry is so extended that the accumulated shipments from all the producing States and Territories now render it impossible for a shipper to tell what numbers of live stock are being moved and prepared for shipment to the prominent markets of our country from day to day; but it is believed that by a system of telegraphic and mail information under co-operative direction of bureaus of information in the several States, the quantity of live stock shipped or in preparation for shipment from each State daily can be easily ascertained, and that this information would be of great assistance to shippers in avoiding glutted markets.

A vote was passed in favor of the inspection of American meats by the general government, on the ground that this would give our meats such a guarantee of purity and healthfulness that there would no longer be any excuse for restrictions against their importation into foreign countries. Measures for the prevention and extermination of pleuro-pneumonia, splenic, and "Texas fever" were discussed, and the work of this Department in these lines was indorsed. The establishment of deep-water harbors on the Gulf of Mexico, and of refrigerator slaughter-houses at various points in Texas, with sufficient capacity to handle the surplus beef for export from the great regions of the Southwest, was strongly favored.

EXPERIMENT STATION NOTES.

COLORADO STATION.—A new botanical and horticultural laboratory has just been completed. Experiments with grasses at the grass station on the plains above the level of irrigation are reported to be progressing favorably.

DELAWARE STATION.—Thirteen co-operative field experiments with corn, sweet potatoes, strawberries, and peaches, and in rotation of crops, are in progress in different parts of Delaware under direction of the station in connection with the State Grange. Variety tests of small fruits are also being conducted by twelve fruit-growers in co-operation with the station. Experiments with potatoes treated with the Bordeaux mixture indicate that the plant assimilates copper in amounts too small to injure health, and that a relatively large part of the amount assimilated is stored in the skin of the tubers. Charles W. Roberts, of West Chester, Pa., has been elected a trustee of the college and station.

FLORIDA COLLEGE AND STATION.—H. F. A. Kleinschmidt, B. S., has resigned the professorship of manual training and mechanical engineering. J. C. Neal, Ph. D., and J. J. Earle, B. A., will hereafter devote themselves exclusively to station work.

INDIANA STATION.—H. E. Stockbridge, Ph. D., has resigned the directorship, and the vice director, C. S. Plumb, B. S., is at present in charge of the station.

KENTUCKY STATION.—Hart Gibson has succeeded P. P. Johnston as a member of the board of control. The director and other members of the station staff are frequently called upon to address farmers' institutes in different parts of the State.

MARYLAND STATION.—W. H. Bishop has resigned the position of horticulturist of this station, to take effect September 1, 1890. He will assume the management of the agricultural department of Tougaloo University, Tougaloo, Miss.

MASSACHUSETTS HATCH STATION.—Experiments are being made regarding the influence of electricity upon the growth of plants, by passing a current through the soil. The State Board of Agriculture have so approved the work of the station as to publish extra editions of its bulletins on Tuberculosis and on the Gipsy Moth. Every Grange in the State has sent the station a list of its members, desiring that the station bulletins be sent them.

MICHIGAN STATION.—Horace C. Spencer, of Flint, Mich., has been appointed a member of the State Board of Agriculture (which is the governing board of the station), vice W. B. McCreery, resigned. R. C. Kedzie, M. A., is making a careful record of temperatures with the thermometer exposed to the full light of the sun, with reference to the effect of temperature upon plant growth. The facilities for the investigation of animal diseases have lately been enlarged by fitting up rooms in the upper story of the veterinary laboratory. A feeding experiment with ten steers of different breeds is nearly completed. E. Davenport, M. S., agriculturist of the station, has begun extensive field experiments.

MISSISSIPPI STATION.—Three branch stations are to be established, one in the prairie region in Northern Mississippi, another in the pine woods region, both for a study

of fertilizers; and a third on the Gulf coast for work with rice, sugar-cane, and semi-tropical fruits. E. R. Lloyd, M. S., has been made station agriculturist.

NEBRASKA STATION.—Hudson H. Nicholson, M. A., chemist of the station, has been elected director. During the year past the mailing list has increased fourfold. Explanations of the station work by Director Hicks in lectures at farmers' institutes, and the issuing of press bulletins, which have been widely reprinted in newspapers, are believed to account for this increase.

NEVADA STATION.—Especial attention is now being given to analyses of soils, waters, and ores, and to experiments with insecticides and with varieties of grasses, with reference to their value under irrigation. The State has recently given the station the use of 29½ acres of land for experimental purposes.

NEW HAMPSHIRE STATION.—D. E. Stone, B. S., has been added to the staff as general assistant. A barn 100 by 40 feet has been erected and will be used exclusively as a stock barn. An experiment is in progress with a system of "alternate husbandry" as a means of improving pastures and increasing the stock-carrying capacity of the farm. Investigations of the feeding value of skim-milk for pigs, and digestion experiments are announced. A two-years test of breeds of dairy cows closed July 1, and a report for both years will be issued soon.

NEW MEXICO STATION.—The citizens of Mesilla Valley have donated a farm of 120 acres to the station. Part of the farm was in common crops, cultivated with primitive methods; the rest was virgin soil. Irrigation was necessary. One section of the farm is "mesa" land, above irrigation level, and covered with native mesquite and tornillo. Is receives only the scanty rain-fall of the arid region. This has been cleared and reveals a soil of apparently great fertility. The farm has been fenced, irrigating ditches constructed, leveling done, and buildings begun. The land is being planted with common crops to bring it into subjection.

THE NEW YORK STATE STATION.—The State legislature has passed an act requiring that commercial fertilizers offered for sale, to be used in the State, shall be accompanied by analyses stating the percentages of valuable ingredients. Manufacturers, agents, and sellers of fertilizers are required each July to furnish the director of the station with a list of the fertilizers manufactured or offered for sale in the State, with names of brands and statements of analysis. Whenever fertilizers are shipped or sold in bulk for use of farmers in the State, statements must be sent to the director of the station, giving the name of the goods and accompanied with an affidavit from the seller giving guaranteed analysis. The act applies to fertilizers of which the selling price is $10 per ton or higher. Violations of the act are punishable by fine of not less than $50 nor more than $200 for a first offense and double the amount for a second offense, in the discretion of the court. The director of the station is charged with the enforcement of the provisions of the act, is required to prosecute for violations, and is authorized to employ agents, counsel, chemists, and experts. The sum of $20,000 is appropriated from the State treasury to pay expenses of enforcement of the act. Any fines collected may also be applied to this purpose.

NEW YORK CORNELL STATION.—Harry Snyder, B. S., has been elected assistant in chemistry, vice W. P. Cutter, B. S., now chemist of the Utah Station. Clinton D. Smith. M. A. S., succeeds Ed Tarbell, assistant in agriculture, who resigned July 1.

NORTH DAKOTA STATION.—The station recently organized in North Dakota has begun experiments with grasses for hay and pasture, varieties of wheat under different methods of cultivation, silage, and sugar-beets. An effort is also being made to collect and classify the natural grasses and noxious weeds of the State.

OHIO STATION.—The bulletins of this station are issued monthly at the expense of the State. The last legislature, by unanimous vote, increased the edition from 15,000 to 60,000 copies. The station has now about 40,000 names on its mailing list. The same legislature voted the station other appropriations as follows: for finishing

and furnishing rooms for museum library, $600; for outfit of chemical laboratory, $1,000; for farm engine and repairs on barn, $1,200; for supplies for entomological division, $200; for expense of board of control, $200; total, $3,200. June 11 the State Horticultural Society held its summer meeting at the station.

PENNSYLVANIA STATION.—At the last session of the legislature an appropriation of $7,000 was made to the station for a dairy-house and feeding barn, and for improvements in the present barn. This work is now under way. A dairy-house will be erected in accordance with plans furnished by a cold storage company, and so arranged as to admit of controlling the temperature of the work-rooms. The other improvements include a barn for use in the more elaborate feeding experiments, a horse barn, carriage house, hog house, and a covered barn-yard. As hitherto, the attention of the station is largely turned toward problems connected with the economic feeding of domestic animals. In this connection a grass garden has just been started upon the plan adopted a few years since by the Connecticut State Station.

RHODE ISLAND SCHOOL AND STATION.—In March, 1890, the legislature appropriated $50,000 for the erection of school buildings, and made provision for an annual appropriation of $10,000 for the support of the school. The buildings, which are located on the station farm, are now well under way, and it is expected that the school will be open for students in September. The station laboratory, erected with the aid of an appropriation of $14,000 from the State, is now ready for occupancy. An orchard has been planted with many varieties of apples, pears, peaches, plums, and cherries. Grapes and small fruits have also been set out. Numerous improvements are being made in the buildings and the farm. Co-operative field tests with fertilizers for corn have been undertaken in different parts of the State under the supervision of the station. James H. Eldredge, M. D., of East Greenwich, has been appointed a member of the board of managers, vice C. A. Shippee, whose term had expired.

TEXAS STATION.—F. A. Gulley, M. S., has resigned the directorship and is succeeded by G. W. Curtis, M. S. A., agriculturist of the station.

UTAH COLLEGE AND STATION.—The board of trustees of the college and station as now organized includes William S. McCornick, Salt Lake City, president; William N. Brown, Provo; Christian F. Olsen, Hyrum; Robert W. Cross, Ogden; Melvin B. Sowles, Salt Lake City; John E. Hills, Provo; James T. Hammond, Logan. John T. Caine, jr., is secretary of the board, and H. E. Hatch, treasurer. The faculty are: Jeremiah W. Sanborn, B. S., president, professor of agriculture; Evert S. Richman, M. A. S., professor of horticulture and botany; William P. Cutter, B. S., professor of chemistry; Abbie L. Marlatt, B. S., professor of domestic economy; J. M. Sholl, professor of mechanical engineering; Alonzo A. Mills, B. S., farm superintendent. The station staff is organized as follows: J. W. Sanborn, B. S., director; E. S. Richman, M. A. S., horticulturist and entomologist; W. P. Cutter, B. S., chemist; A. A. Mills, superintendent of experiment work; J. R. Walker, clerk and stenographer; H. E. Hatch, treasurer. A farm-house, a laboratory, a barn, and two cottages are being built at a cost of over $14,000, the legislature of the Territory having aided the station with liberal appropriations for buildings, live stock, etc. Eighty-five acres of ground are devoted to experimental purposes.

VIRGINIA STATION.—W. B. Preston has resigned the directorship and President L. L. Lomax, of the Agricultural and Mechanical College, is acting director. T. L. Watson has been elected assistant in chemistry, vice B. F. Finney, and W. W. Hurt has been appointed clerk and stenographer. The station has been divided into the following departments: agriculture, botany (including horticulture) and entomology, chemistry, and veterinary science. The board of visitors of the college has committed the management of the station to three of its members as a board of control. The internal affairs of the station will be managed by a council, consisting of the heads of the several departments, with the president of the college as chairman.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

MAY 1 TO JULY 1, 1890.

First Report of the Secretary of Agriculture, 1889.

BUREAU OF ANIMAL INDUSTRY:

Special Bulletin, May, 1890.—Proceedings of an Interstate Convention of Cattlemen held at Fort Worth, Texas.

The Animal Parasites of Sheep.

DIVISION OF STATISTICS:

Report No. 73 (new series), May, 1890.—Condition of Winter Grain; Progress of Cotton Planting; Wages of Farm Labor.

Report No. 74, June, 1890.—Report of Acreage of Wheat and Cotton; Condition of Cereal Crops.

DIVISION OF MICROSCOPY:

Twelve Edible Mushrooms of the United States.

DIVISION OF BOTANY:

Contributions from the United States National Herbarium, No. 1, June 13, 1890.

SECTION OF VEGETABLE PATHOLOGY:

Bulletin No. 2, February, 1890.—Experiments made in 1889 in the Treatment of Fungous Diseases of Plants.

Quarterly Bulletin, Vol. VI, No. 1, March, 1890.—Journal of Mycology.

Treatment of Plant Diseases.—Extract from Journal of Mycology, Vol. VI, No. 1.

DIVISION OF ENTOMOLOGY:

Periodical Bulletin, Vol. II, No. 10, April, 1890.—Insect Life.

Periodical Bulletin, Vol. II, Nos. 11 and 12, May and June, 1890.—Insect Life.

Bulletin No. 22.—Reports of Observations and Experiments in the Practical Work of the Division.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Bulletin No. 5, March, 1890. Organization Lists of Agricultural Experiment Stations and Agricultural Schools and Colleges

Experiment Station Bulletin No. 6, May, 1890.—List of Botanists of the Agricultural Experiment Stations, and Outline of Work in Botany at the Several Stations.

Farmers' Bulletin No. 2, May, 1890. Work of the Agricultural Experiment Stations.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

MAY 1 TO JULY 1, 1890.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Bulletin No. 14 (new series), April, 1890.—Pea Vines as a Fertilizer.

Bulletin No. 15 (new series), April, 1890.—Insecticides.

ALABAMA CANEBRAKE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 8, April, 1890.—Cattle and Pig Feeding.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF CALIFORNIA:

Bulletin No. 86, May 17, 1890.—Preservative Fluids for Fresh Fruits.

Bulletin No. 87, June, 1890.—The Conservation of Wines.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 103, May, 1890.—Fertilizers.

STORRS SCHOOL AGRICULTURAL EXPERIMENT STATION:

Annual Report, 1889.

AGRICULTURAL EXPERIMENT STATION OF FLORIDA:

Bulletin No. 9, April, 1890.—Entomological Notes.

GEORGIA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 7, April, 1890.—Analyses of Food Stuffs; Meteorology; Destructive Leaf Hopper.

IOWA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 9, May, 1890.—Comparative Value of Fodder Plants; Iowa Station Milk Test—a Correction; "Relative Value Plan" at Creameries; the Plum Curculio and Plum Gouger.

KENTUCKY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 26, April, 1890.—Corn Experiments.

Bulletin No. 27, April, 1890.—Experiments with Commercial Fertilizers on Hemp.

Circular No. 3, April, 1890.—Means of Lessening Injuries from Insects and Fungi.

Bulletin No. 28, May, 1890.—Tobacco Experiments.

LOUISIANA SUGAR EXPERIMENT STATION:

Bulletin No. 28.—Field Experiments.

MAINE STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Annual Report, Part II, 1889.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:

Analyses of Commercial Fertilizers, May and June, 1890.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Bulletin No. 9, May, 1890.—Soil Tests with Fertilizers.

Meteorological Bulletins Nos. 16 and 17, April and May, 1890.

Special Bulletin, May, 1890.—On the Most Profitable Use of Commercial Manures

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:

Bulletin No. 59, April, 1890.—Fruit List and Apple Scab.

Bulletin No. 60, April, 1890.—Pigs—Breed Tests; Potatoes—Variety Tests.

Bulletin No. 61, April, 1890.—Foul Brood.

Bulletin No. 62, May, 1890.—The English Sparrow.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF MINNESOTA:

Bulletin No. 10, March, 1890.—Onions, Cabbage, London Purple for Curculio on Native Plums, Bagging Grapes, Rollingstone Plums, Potatoes, Oak Caterpillars.

Bulletin No. 11, June, 1890.—Pruning Roots of Corn, Deep *vs.* Shallow Cultivation, Improving Corn, Cross-Fertilization and Selection, Peas, Beans, Flax, and Other Crops; Results of Seeding Rusted, Frosted, and Frozen Wheat of 1888; Further Observations.

MISSOURI AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 11, May, 1890.—Texas Fever.

AGRICULTURAL EXPERIMENT STATION OF NEBRASKA:

Press Bulletin No. 1.—Organization, Work, and Publications of the Station.

Press Bulletin No. 2.—Wheat Rust.

Bulletin No. 14, June, 1890.—Insects Injurious to Young Trees on Tree Claims.

NEVADA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 8, January, 1890.—The Codling Moth

Bulletin No. 9, May, 1890.—A Serious Rose Pest.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 16, March, 1890.—Growing Corn for Fodder and Silage.

Bulletin No. 17, May, 1890.—A Description of Cochran's Method for the Determination of Fat in Milk, for the Use of Dairymen.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 70, April, 1890.—The Weed Pests of the Farm; Japan Clover.

Press Bulletin No. 1, May 24, 1890.—What is the Use of an Experiment Station? Cow-Peas for Wheat; Grapes at North Carolina Experiment Station; Value of Japan Clover.

Annual Report, 1889.

OHIO AGRICULTURAL EXPERIMENT STATION:

Bulletin Vol. III, No. 3 (second series), March, 1890.—Experiments with Corn and Oats; Actinomycosis, or "Big Jaw" of Cattle.

Bulletin Vol. III, No. 4 (second series), April, 1890.—Spraying to Prevent Insect Injury; Bark Lice of the Apple and Pear; the Buffalo Tree Hopper; Insects affecting Corn; the Ox Warble Fly or Bot Fly; Fungous Diseases of Plants and Remedies; Directions for Collecting, Preserving, and Studying Plants.

OREGON EXPERIMENT STATION:

Bulletin No. 4, January, 1890.—Farm Crops; Vegetables; Ornamental Trees and Shrubs; Orchard and Small Fruits; Chemical Analyses.

Bulletin No. 5, April, 1890.—Entomology; Gophers and Rabbits; Fertilizers.

Annual Report, 1889.

THE PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 11, April, 1890.—Indian Corn as a Grain and Fodder Crop.

RHODE ISLAND STATE AGRICULTURAL EXPERIMENT STATION:

Second Annual Report, 1889.

SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 8 (new series), March, 1890.—Chemical Statistics of Corn Crop of South Carolina; Maize Fodder Silage; Cow-Peas as a Forage Crop; Composition of Soja Bean Vines.

South Dakota Agricultural Experiment Station:

Bulletin No. 17, March, 1890.—Small Grain.

Bulletin No. 18, March, 1890.—The Cut Worm.

Tennessee Agricultural Experiment Station:

Bulletin Vol. III, No. 1, January, 1890.—Experiments in Growing Potatoes.

Bulletin Vol. III, No. 2, April, 1890.—Tests of Varieties of Barley, Corn, Oats, Wheat, and Sorghum; Methods of Culture of Wheat, and Effects of Fertilizers on Oats and on Clover.

Special Bulletin C, May 10, 1890.—Treatment of certain Fungous Diseases of Plants.

Texas Agricultural Experiment Station:

Bulletin No. 7, November, 1889.—Cotton Root Rot.

Bulletin No. 8, December, 1889.—Work in Horticulture.

Bulletin No. 9, May, 1890.—Pear Stocks; some Parasitic Fungi of Texas.

Bulletin No. 10, May, 1890.—Feeding Experiment.

Vermont State Agricultural Experiment Station:

Bulletin No. 19, April, 1890.—Questions Concerning Injurious Insects.

Bulletin No. 20, May, 1890.—Analyses of Fertilizers Licensed for Sale in the State of Vermont for the year 1890.

Virginia Agricultural Experiment Station:

Bulletin No. 5, March, 1890.—Composition of Feeding Stuffs; Analyses of some Feeding Stuffs.

Bulletin No. 6, March, 1890.—Variety Tests with Potatoes.

West Virginia Agricultural Experiment Station:

Second Annual Report, 1889.

DOMINION OF CANADA.

Department of Agriculture:

Reports of Experimental Farms for 1889.

Bureau of Industries, Toronto, Ontario:

Bulletin No. 32, May 1, 1890.—Crops and Live Stock in Ontario.

Guelph Agricultural College:

Bulletin No. 48, May, 1890.—Butter Making.

Bulletin No. 49, May, 1890.—Corn Silage for making Beef.

Bulletin No. 50, June, 1890.—Corn Silage.

Bulletin No. 51, June, 1890.—Fattening Lambs.

EXPERIMENT STATION RECORD.

Vol. 2. SEPTEMBER, 1890. No. 2.

EDITORIAL NOTES.

Frequent inquiries have been received at this Office in regard to the ways in which the station funds received from the General Government may be legally and properly expended. The following letters are published as indicating the opinions held by the Department of Agriculture in regard to the matters referred to:

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS.

DEAR SIR: In answer to your inquiry regarding the proper use of the funds given by Congress to experiment stations, I may repeat what was said in response to a previous inquiry received at this Office.

The specific question was whether the experiment station funds must be used for experiment station purposes exclusively, or whether they might be applied in part, either directly or indirectly, to college purposes also. The answer was, in substance, as follows:

This Department does not make decisions in such cases, but gives its opinion and advice when called for. To this question the answer is perfectly clear. The funds are for experiment station purposes, and for those only. The act of Congress of March 2, 1887, providing for the establishment of the stations, states distinctly, in section 2, "the object and duty of the stations," namely, "to conduct original researches or verify experiments" upon subjects of the classes named; and in section 5, defines the purposes for which the grants of money may be used, namely, for (1) paying the necessary expenses of conducting investigations and experiments; (2) printing and distributing the results; and (3) the erection, enlargement, or repair of buildings necessary for carrying on the work of the stations.

The intent of the act, thus definitely stated in its phraseology, is also shown in the report of the Committee on Agriculture of the House of Representatives which accompanied the bill as presented to the House (See pp. 61-66 of Experiment Station Bulletin No. 1, of this Office). As an argument in favor of the establishment of experiment stations to be connected with colleges, that report urged that the work of experimenting by the colleges had been but "imperfectly provided for," that this measure would provide for it, and in so doing would "utilize the buildings, laboratories, farms, libraries, and apparatus belonging to the institutions which Congress has already established, and thus supplement for a specific end [namely, experimental inquiry] the appliances already created for general ends." In other words it was the clear expectation that, in accepting this trust, the colleges, so far from making use

of the experiment station appropriations for general college purposes, would devote the money specifically to research and what properly pertains thereto, and that they would supplement it and increase its effectiveness by placing at the disposal of the stations the facilities for experimental inquiry which they already possessed. And this was urged as one of the strong arguments in favor of the measure, both in presenting it to the attention of Congress and in urging the passage of the bill.

The expenditure of both college and station funds by the college authorities involves some delicate questions of adjustment. For instance, it frequently happens that the same person renders service to and is paid by both institutions, as when an officer of the college shares in the work of the station. Such an arrangement may be advantageous to both college and station and entirely proper, provided the interests of the station call for the work, the person has the time and the qualifications needed, the college pays a due equivalent of salary for the service it receives, and the station receives a due equivalent of service for the salary it pays. In like manner the funds of both institutions are sometimes expended for buildings and appliances which both use. This, too, may be permissible provided it is not done for the college at the expense of the station. The principle to be borne in mind is that in granting aid from the National Government, it was the expectation of Congress that the resources of the colleges would be used in furtherance of the work of the stations, but not that the grants to the stations should be diverted to the aid of the colleges.

The men who are responsible for the management of the colleges and deeply interested in their welfare, often feel keenly their lack of means, and the temptation to use the resources of the stations to help the colleges in return for the help given to the stations is often strong. But in the acceptance of the station grant, their integrity is pledged to its proper use. To employ any part of it, directly or indirectly, for the support of the college or for any other purposes than those defined by the act of Congress, namely, for conducting experiments, publishing and otherwise disseminating information obtained, and for buildings needed and used by the station, would be a breach of trust, a violation of both the letter and the spirit of the law. Of course the connection of the stations with the colleges inures to the benefit of the latter in numerous and important ways. The atmosphere of research, so useful to both teacher and student, is developed; information is obtained which the colleges want to impart; the colleges are brought into closer contact with the world of science on the one hand and with the people on the other. Thus their intellectual tone is elevated, their influence enlarged, and their usefulness greatly increased. Such benefit is in every way legitimate and desirable. But in some cases there has seemed to be a tendency to utilize the means of the station for the support of the college, and at the station's cost. The effect of this must be injurious, not only to the individual stations concerned, but to the enterprise as a whole. It is on these accounts and because the obligations imposed by the law have seemed to me to be not always understood, that I have made these statements so implicit. I inclose copy of a letter of similar import from Assistant Secretary Willits.

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Respectfully,

W. O. ATWATER,
Director.

The following refers to the letter above quoted:

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE ASSISTANT SECRETARY,
Washington, D. C., July 19, 1890.

DEAR SIR: In response to your inquiry I may say that your communication of this date to the director of the ———————— Experiment Station does not, in my judgment, overstate the obligation of the agricultural colleges to the stations.

As a member of the committee which represented the agricultural colleges in urg-

ing the passage by Congress of the bill establishing the stations, I can testify that it was the expectation of the promoters of the movement and of Congress "that the general resources of the colleges would be used in furtherance of the work of the stations, but not that the grant to the stations should be diverted" to any general college purposes. This was clearly set forth in the Hatch bill and the report of the Agricultural Committee of the House which accompanied it, and "was used as one of the strong arguments in favor of the measure."

In the passage which you have quoted from the law the objects of the stations and the purposes for which the means granted by Congress may be used are clearly defined. No university, college, or school to whom that money is intrusted has any right to use any part of it for the benefit of its treasury, its property, its work of instruction, its officers or its students, except in so far as that benefit accrues from what is done by the station in the specific work with which it is charged. The colleges may and should aid the stations by placing at the disposal of the latter, for experimental purposes, their buildings, libraries, laboratories, land, and other appliances, but this gives them no reciprocal claim upon the station funds granted by Congress. The expenditure of station money or other use of station resources, directly or indirectly, in the interest of the other departments of the colleges and to the disadvantage of the stations, whether it be to relieve the college treasuries, or to pay salaries for college work, or to provide for buildings or lands, or improvements of buildings or grounds, or for libraries, or for apparatus, or for services other than are demanded and intended to be used in good faith for station purposes, as those purposes are defined by the law, would be a violation of both its letter and its spirit.

My experience and observation, I regret to say, confirm your statement as to the danger that some colleges may, at times, under financial stress, and without perfect understanding of the import of the law, be tempted to overstep the limits of strict propriety, and I deem it important, therefore, that the attention of those institutions shall be called to the strict obligations involved in the expenditure by the colleges of the grant. In saying this I wish to be understood as making no general reflections upon the purposes or conduct of the authorities of those institutions.

There is another matter which is referred to only incidentally in your communication, but to which I think more specific attention should be called. The grant of an experiment station appropriation to a particular institution, in a particular community, is not intended for the special benefit of that institution or that community, but for the good of the State and the general public. Any tendency to use the resources of the station for individual or local advantage is wrong. So likewise the division of the experiment station's funds among different localities of a State may be productive of harm. In general, the work of an experiment station must be concentrated in order to be more useful. To divide it is to endanger its efficiency. Doubtless in many cases the establishment of substations in different parts of a State under the control of the central station has been both wise and advantageous, but the practice, especially when any of the resources of the station are used for the purchase of land or buildings, is a matter whose expediency should be proven before the steps are taken.

Aside from the right and wrong of these matters, there is another important consideration. The eyes of the public, of men of science, and of Congress are upon the stations. Errors of inexperience may for a time be excused; but failure to use the funds in good faith means risk of losing the support which the stations now receive from the people and the appropriations which they receive from the Government.

Respectfully,

EDWIN WILLITS,
Assistant Secretary.

PROF. W. O. ATWATER,
Director, Office of Experiment Stations.

The following letter was written in reply to questions addressed to the Director of this Office. They were:

First. Can the experiment station fund, or a portion of it, be properly used for the purpose of organizing farmers' institutes or clubs, and thus perfecting an organization among the farmers of the State; or more generally, can the fund, or a portion of it, be properly used for any purpose except that of conducting original research or verifying experiments?

Second. What item of experiment station expenditure, in the opinion of the Director of the Office of Experiment Stations, and in the light of his experience with American and European stations, is likely to be the largest one?

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., June 5, 1890.

DEAR SIR: In response to the inquiries of yours of May 29, permit me to say:

First. Section 2 of the act of March 2, 1887, providing for the establishment of agricultural experiment stations, makes it "the object and duty of said experiment stations to conduct original researches or verify experiments" on subjects related to agricultural industry, due regard being had to the conditions of the States and Territories in which the several stations are established. Section 5 provides that the grants made by Congress for the support of the stations shall be used for "paying the necessary expenses of conducting investigations and experiments, and printing and distributing the results," and for buildings.

While reasonable discretion would, in my judgment, be permissible in deciding how the purposes thus clearly defined may be carried out by the stations in the use of the grant from the Government, it is certainly very clear that the employment of that "fund, or any considerable portion of it, for the purpose of organizing farmers' clubs and perfecting in this way an organization among the farmers" of a State, or indeed any material diversion of the fund for objects other than those mentioned, would be improper.

Second. My experience with agricultural experiment stations in this country and in Europe, to which you refer, indicates that the chief item of expenditure in conducting the work of the stations, "supposing them to be fairly well equipped," is likely to be, and certainly ought to be, for the employment of trained men to conduct the experiments and investigations with which these institutions are charged.

The success of the stations in meeting the practical wants of the farmers will be proportioned to what they discover of the laws that underlie the practice of farming. For this purpose scientific research is the great essential. What the stations most need is the labor of trained investigators, of competent specialists in the lines of inquiry called for by the wants of the agriculture of their respective localities.

Of course, means for doing the work and disseminating the results are essential, and wise discretion must be used in the distribution of the fund for these purposes. But experience has justified the general practice of the best stations, by which the largest item of expense is made that of employment of capable workers.

Very respectfully,

W. O. ATWATER,
Director.

ABSTRACTS OF BULLETINS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

Alabama College Station, Bulletin No. 13 (New Series), March, 1890 (pp. 16.).

A MICROSCOPIC STUDY OF CERTAIN VARIETIES OF COTTON, P. H. MELL, PH. D.—This includes a brief description of the three important commercial varieties of cotton; a definition of cotton fiber; a list of the varieties examined; statements of results and conclusions; suggestions as to the improvement of the grade of cotton by attention to selection of the seed, character of the soil, methods of cultivation and manuring, and climatic conditions; tabulated results of the microscopical examination of the fiber; and two plates illustrating differences in the fibers of different varieties of cotton.

Samples of cotton representing eighteen varieties grown on the station farm—sea-island cotton from Savannah, Georgia, and "Bailey" fiber from North Carolina—were examined microscopically.

Among the questions considered were: "(1) How many real varieties of cotton exist? (2) In forcing the plant under high cultivation is the fiber improved, or is simply the 'weed' enlarged to the detriment of the staple? Is it not often the case that the fruit of the cotton plant is damaged by too rapid maturing, just as the fruit of the peach is known to be immature at the center in some early forced varieties? (3) What is the effect produced on the fiber when caught by frost just as the boll opens? (4) At what stage of the growth and maturity of the boll does the fiber attain its full development?"

Data relating to only the first two questions are reported in this bulletin, the investigations on the other two not having been carried far enough to warrant the publication of conclusions. Results of microscopical examinations are given in detail and summarized in tabular form. The experiments indicate "that it is not always the large plant that produces the best condition of the fiber, and that the most excellent condition of the fiber is produced only on plants which are neither too rapid nor slow in their development, and which are given all the advantages of judicious cultivation with the proper manuring and under the most favorable conditions of the atmosphere. In improving the grade of cotton the plant must be forced to produce fiber that is (1) long, and as nearly as possible uniform in length; (2) of uniform diameter throughout; (3) flat and ribbon-like, and well twisted." Seed

selection should be repeated from year to year, and no inferior cotton planted near enough to vitiate the chosen variety with its pollen. In these experiments the strongest fiber was produced by the Truitt variety; the largest by Barnett; the smallest by No. 1 Hawkins' Improved, and Peterkin; the longest by Okra Leaf; the shortest by No. 2; and the best twisted by Truitt, Rameses, and Cherry's Cluster.

The largest percentage of fiber per boll was produced by Welborn's Pet, Okra Leaf, Peterkin, Hawkins' Improved, King's Improved, and in the order named. The largest percentage of seed per boll was produced by Zellner, Rameses, Southern Hope, Truitt, and in the order named. The best grade of cotton, taking all things into consideration, is Cherry's Cluster. The second best grade is Truitt.

Delaware Station, Bulletin No. 8, March, 1890 (pp. 16).

EXPERIMENTS TO TEST THE POSSIBILITY OF DEVELOPING A DOMESTIC SUGAR INDUSTRY, A. T. NEALE, PH. D. (pp. 3–11).—In the crop rotations followed in the Northern Atlantic States for nearly a century, Indian corn has been commonly grown once in every four or five years. The low price of corn has of late created a demand for a substitute crop similar to corn in its habits of growth and in its demands on the soil. The products of this crop should also, as in the case of corn, be able to endure transportation and storage, and be used for daily consumption in every family. "Sorghum is the only plant which either fulfills or can be made to fulfill all of the above conditions. Its leading product should be refined sugar."

The problems relating to sorghum are discussed in this bulletin from the standpoints of the sugar boiler and the farmer. The author speaks from several years' experience in New Jersey in connection with investigations on the field culture and chemical composition of sorghum, and on the manufacture of sugar from this plant. After seven or eight years of hard work and bitter disappointments, the sugar men can now justly claim to be able to extract, commercially and economically, 90 per cent of all the sugar present in the cane. The product up to this point will be a heavy sirup. If the cane is of good quality 75 per cent of the sugar in this sirup can be delivered to sugar refiners in the form of old-fashioned, heavy brown sugar. The other 25 per cent will remain as a low-grade molasses, worth at wholesale, at present, about 20 cents per gallon.

"If, however, the cane delivered by the farmer is of low grade, then the sugar men can only guarantee to waste not more than 15 pounds of sugar in each ton of field sorghum; their product will be sirup only, for, from such stock, they will be unable to extract with profit even low grade refining sugar.

"In explanation of the terms low grade and high grade sorghum, it may be stated that if all of the water in cane juice is boiled away, a mixture of sugar and of foreign matter will remain. If out of 100 pounds of this mixture from 66 to 75 pounds is sugar, then cane yield-

ing such juice would be graded first-class. If, however, the mixture contained less than 60 pounds of sugar per hundred, then the cane would grade low as fit only for molasses. 'Purity' is the technical expression for the above standard. Sixty-six purity would represent a high grade sorghum, and 59 purity a low grade.

"Ranking with purity in importance, stands the percentage of sugar in the cane juice. If 100 pounds of said juice contain less than 9 pounds of sugar, this cane is fit only for molasses.

"The following tabular statement rests upon a number of assumptions, each of which is warranted by experience.

"(1) During September, field sorghum will lose 30 per cent of its weight by the removal of its leaves, sheaths and seed tops. One ton of field sorghum, therefore, is equivalent to 1,400 pounds of cleaned cane.

"(2) Approximately 10 per cent of this cane is fiber and insoluble matter; 90 per cent, therefore, may be roughly classified as cane juice. On this basis 1 ton of field sorghum contains 1,260 pounds of 'juice.'

"(3) Assuming that the purity of this juice is at least 66, then per ton of cane averaging from 9 to 13 per cent the following quantities of sugar and molasses may be secured, on a commercial scale, the extraction being 90 per cent and the crystallization 75 per cent:

Per cent sugar in cane juice.	Amounts of products per ton field cane		Value of products per ton field cane.		Total value of sugar products per ton field cane.
	Raw sugar 90 per cent pure.	Raw molasses 38 B	Sugar at 5 cents per pound.	Molasses at 20 cents per gallon.	
	Pounds.	*Gallons*			
9 00	75	11.6	$3 75	$2.32	$6 07
10.00	83	13.0	4.15	2.60	6.75
11 00	91	14 4	4.55	2.88	7.43
12 00	99	15.8	4.95	3.16	8 11
13.00	107	17.2	5 35	3.40	8.75

"This statement brings out the commercial difference between a 9 and a 13 per cent cane. From the standpoint of to-day the possible products from the former have a wholesale market value of $6.07 per ton; those from the latter are worth $8.75; four per cent of sugar makes a difference of $2.68 per ton of field cane. The total expenses of the sugar-house, working 50 tons daily, should average less than $2.25 per ton.

"A season of 70 working days is possible in this latitude. A crop of 3,500 tons of field cane would therefore be an ample supply; its products would vary in value from $21,000 to $30,000, according as the cane varied from 9 to 13 per cent of sugar. The running expenses of such a house would not vary far from $8,000, and would not be noticeably affected by the quality of the cane. Farmers can not afford to raise sorghum for less than $2.50 per ton; the crude stock, therefore, would ap-

proximate $9,000 in value. Hence the total expenses would approximate $17,000, leaving, with 9 per cent cane, a margin of $4,000; this margin is too small to offset possible losses, which may be caused either by accidents or by fluctuations in markets. With 13 per cent cane, expenses could be paid if sugar fell to 3 cents per pound and molasses to 13 cents per gallon.

THE FARMER'S STANDPOINT.

"The farmer is called upon to furnish 3,500 tons of sorghum, the juice of which must contain not less than 9 per cent of sugar. This crop is to be delivered at the rate of 50 tons daily. Ripe cane can be taken to the sugar-house on and after the 20th of August; the last load should be delivered before the 1st of November.

"Three thousand five hundred tons of rich cane can not be grown on less than 250 acres, and this land must be so close to the sugar-house that hauling expenses need not exceed 50 cents per ton. In order to provide against deterioration of cane, excessive labor in checking weeds, the depredations of insects, etc., rotation is as necessary with sorghum as with Indian corn.

"No one variety of cane can be relied upon to keep a sugar-house in crude stock for seventy days."

Early maturing varieties should be used for the first part of the season, white-seeded varieties for the middle, and late varieties for the last part. The varieties now in use need improving.

"From two standpoints, therefore, viz., that of the farmer and that of the chemist, the interest centers on the development of varieties, and it is firmly believed that the possibilities of a profitable domestic sugar industry turn on this point."

"By making business-like charges against the crop for rent of land, for fertilizers, for labor, hauling, etc., it will be evident that an expenditure of about $30 per acre will oftentimes be reached in securing a full crop of cane and delivering it at the sugar-house. Fifteen tons per acre should be, therefore, the minimum yield in order to make a profit possible.

"Roughly summarized, the farmer's problem is:

"(1) To secure varieties which will allow him to deliver 3,500 tons of cane at the rate of 50 tons daily.

"(2) To raise sorghum with not less than 9 per cent of sugar and 66 degrees purity at the rate of 15 tons per acre, and at an expense not exceeding $2 per ton.

"Men who are familiar with the sorghum sugar industry in the East feel that if further improvement is possible in the machinery it must be in a better arrangement of parts, by which a still more marked saving of labor can be secured.

"In the chemistry of the industry the field is far broader, for the sugar-house should be prepared to make white sugar fit for direct consump-

tion, and a molasses suitable for the grocery trade. Means should also be found for working cane, even if its purity approximates 55 degrees only. Agricultural chemists feel, however, that it is best to begin with the plant itself, and breed varieties free from objectionable compounds. In support of their position they point to Maercker's sugar-beet seed control, which in eight years' time has aided in raising the purity of beet juice from 82 degrees to 90 degrees."

Tests of a number of varieties were made at the station and by five different farmers in different parts of Delaware from seed sent from the experimental tract of this Department in Kansas.

"A summary of the season's work indicates that, for use in August and September, Folger's Early and Early Amber should be grown. After the middle of September the Honey Dew, the White African, and probably the Kansas Orange should be available. After the 15th of October the Late Orange and an allied variety will be found serviceable.

"As above stated, a margin of profit can be calculated with cane averaging 9 per cent of sugar, but this margin seems too small to justify a step which would hazard any considerable amount of capital. Varieties with 10 per cent and more of sugar were grown this year in Delaware and in New Jersey, and with 3,500 tons of such cane a profitable business would be almost certain."

"All the seed used was guaranteed to have been taken from cane in some cases testing as high as 15 per cent of sugar." The results of the tests reported in this bulletin, however, range from 8 to 11 per cent of sugar, the low percentage being possibly due to the wetness of the season and other unfavorable conditions.

SPRAYING WITH SULPHIDE OF POTASSIUM FOR THE SCAB OF THE PEAR, F. D. CHESTER, M. S. (pp. 11-14).—A report on an experiment in one of the largest pear orchards of the State, located near Newark, which for a long time has been badly infested with scab (*Fusicladium pyrinum*, Fuckel). In 1889 the season was specially favorable for the development of this disease, which affected 90 per cent of the fruit on seven unsprayed trees examined. For this experiment, fourteen trees of the Bartlett, Dutchess, and Lawrence varieties were selected. Seven trees were sprayed five times, between June 11 and August 2, with sulphide of potassium (one half ounce to 1 gallon of water), and the results compared with those obtained from the other seven, which were left unsprayed. The details given show that the different varieties were differently affected by the disease and by the treatment. In general, however, there were twenty-six more marketable pears out of every hundred from the sprayed than from the unsprayed trees. "The total cost per tree for the season's spraying was 5 cents, resulting in an average increase of twenty marketable pears per tree."

LONDON PURPLE FOR THE CODLING MOTH, M. H. BECKWITH (pp. 15, 16).—Notes on an experiment in spraying five Baldwin and two Smith's Cider apple-trees in an orchard near Hare's Corners, New

Castle County, Del., with London purple (16 ounces to 200 gallons of water). Taking the single unsprayed tree examined as a standard, the total yield from the sprayed trees was nearly four times as large as that from the unsprayed trees, and the average yield of sound apples nine times as large. Ninety per cent of the sound apples gathered from the sprayed trees were saved from the attacks of the moth by the use of the insecticide. The sound apples from the sprayed trees were much superior in quality to those from the one unsprayed tree examined.

Georgia Station, Bulletin No. 7, April, 1890 (pp. 9).

ANALYSES OF FEEDING STUFFS, H. C. WHITE, PH. D. (pp. 107–112).—This contains tabulated results of analyses at the station of hay from Bermuda, Johnson and crab-grasses, vetch, white clover, and alfalfa; of mixed and baled western hay (timothy); and of cotton-seed hulls. Similar data from analyses made at the station and elsewhere are also given for the following feeding stuffs: timothy hay, clover hay, maize fodder (cured), pea vines (cured), maize, oats, cow-peas, maize meal, cotton-seed, cotton-seed meal, wheat bran, and oat straw. There are also compiled tables, showing the digestibility of seven feeding stuffs in common use. Feeding standards are quoted.

METEOROLOGY, L. H. CHARBONNIER, PH. D. (pp. 112–114).—Summaries of observations at Athens, Ga., for five years, from October 1, 1884, to September 30, 1889, and for the six months ending March 31, 1890.

NOTES ON A DESTRUCTIVE INSECT, J. P. CAMPBELL, PH. D. (p. 115).—Brief notes on the destructive leaf-hopper (*Cicadula exitiosa*) which injured barley plants at the station farm.

Indiana Station, Bulletin No. 31, April, 1890 (pp. 22).

SMALL FRUITS AND VEGETABLES, J. TROOP, M. S. (illustrated).

Strawberries (pp. 3–7).—Tabulated notes on seventy varieties. "The following varieties are recommended for the farmer's garden: Bubach, Cumberland, Warfield, Logan, Haverland, and Henderson."

Raspberries, blackberries, currants, and gooseberries (pp. 8, 9).—Tabulated notes on 17 varieties of raspberries and 9 of blackberries, with brief descriptive notes on 7 varieties of currants and 4 of gooseberries. "For family use the following varieties of raspberries are recommended: Turner, Brandywine, Cuthbert, Tyler, Ada, Hilborn, Nemaha, and Shaffer for canning."

Potatoes (pp. 10–18).—The date of ripening and yield in bushels per acre are given for ninety-three varieties. "The following varieties seem to be especially worthy of recommendation and further trial: Beauty of Sheba, Breeze, Dictator, Dakota Red, Early Sunrise, Early King, Gold Flake, Great Eastern, Garfield, New Queen, Rose's New Giant, Rural New Yorker No. 2, and Summit."

The yields from planting different numbers of eyes of the Burbank potato are thus stated:

	Market able tubers.	Small tubers.	Total.
One eye........Bushels per acre	103	29	132
Two eyes........do ..	195	40	235
Three eyes........do ..	290	40	330
Four eyes........do....	322	44	366
Five eyes........do....	345	80	425
Six eyes........do...	338	102	440
Whole tubers........do...	381	117	498

The advantage of planting the whole tubers as compared with one and two eyes is shown in the following table:

	Yield of market-able tubers.	Seed required	Net yield.		Yield of market-able tubers	Seed required.	Net yield.
	Bush.	*Bush.*	*Bush*		*Bush.*	*Bush.*	*Bush.*
Whole potatoes......	381	70	311	Whole potatoes....	381	70	311
One eye......	103	7	96	Two eyes........	195	14	181
In favor of whole potato		......	215	In favor of whole potato	.. . ..	....	130

The effect of applying barn-yard manure (quantity and size of plats not stated) for Burbank potatoes on a "moderately fertile soil" which had received no fertilizer for six years, as compared with no manure, is indicated as follows (assuming that the difference in yield was due to the manure and not to disturbing factors of uneven soil, cultivation, etc.):

	Total per acre.	Market-able tubers.	Small tubers.
	Bush.	*Bush.*	*Bush.*
Manured	308	264	44
Unmanured	146	98	48
In favor of manure	162	166	4

Peas (pp. 18, 19).—The dates when ready for market are given for twenty-eight varieties.

"For family use, where a succession is desirable, the following list will give good satisfaction: First and Best, or Early Morning Star, Dan O'Rourke, Minimum, Advancer, Stratagem, and Dwarf Sugar (edible pods). The last named is prepared for the table the same as string-beans, by using pods and all."

Sweet-corn (pp. 20, 21).—Tabulated notes on thirty-six varieties.

"For the farmer's garden the following ten varieties will be found to give good satisfaction with fair treatment. They mature about in the

following order: Early Marblehead, Chicago Market, Crosby; Early Sweet or Sugar, Moore's Early Concord, Rose's Improved Evergreen, Henderson, Honey Sweet, Ne Plus Ultra, Stowell's Evergreen."

Tomatoes (pp. 21, 22).—Brief notes on three varieties.

Sugar-beets (p. 22).—The yields and per cent of sugar are given for five varieties tested in 1888 and 1889.

A trial of a solution called the "new preserver and germinator of cereals and seeds" indicated that it had no special value. Chemical analysis showed its principal constituent to be acetate of lead, worth in the market 6 to 8 cents per pound.

Iowa Station, Bulletin No. 8, February, 1890 (pp. 45).

IOWA STATION MILK TEST, G. E. PATRICK, M. S. (pp. 295–316).—This is an account of "a new dairy test for determining the amount of butter fat in milk." The author states that in the spring of 1889, while engaged in making analyses of milk, he was "impressed anew with the very great need, long felt by farmers, dairymen, and breeders, of a speedy, easily worked, inexpensive, and reasonably accurate method of testing the quality of milk—a method which could be used in the dairy or in the farmer's kitchen, and which would enable the milk producer or the breeder to determine, at trifling expense, the yield of butter fat (or milk fat) from the individual cows of his herd." It is strongly urged that the quality of milk is affected by *individual differences* in cows as much as by differences in breed, and that therefore it is very desirable for the farmer to make sure that each animal in his herd is being fed at a profit. This is emphasized by calling attention to a common estimate that one fourth of the dairy cows in this country are kept at a loss, from which it follows that "one half the cows are kept without profit, for the one fourth at a loss eat up the profits of another one fourth." In other words, one third to one half the capital invested in dairy stock is *dead capital*. The incorrectness of the "somewhat popular 'cream test'" is enforced and experiments made with this test at the Kansas Station are quoted from the First Annual Report of that station, pp. 92, 93. From these experiments it appeared that "in the case of every cow employed, and with each kind of feed, the milk giving the largest display of cream often gave the least butter product, and the reverse." As regards creameries where milk is paid for on this basis the chief loss falls on the farmers who furnish the best milk. "The farmer whose Jerseys, as in the case of our 'Pansy,' gave 9½ to 10 per cent of cream, yielding nearly 5 per cent of butter, must, if all patrons are paid alike, contribute in the course of a year a very pretty sum towards the support of his neighbor's herd of scrubs, which, like our 'White' and 'Ruby,' gave nearly 11 per cent of cream and only 3⅜ per cent of butter."

The milk test.—The test devised by the author is described in detail. The principle consists in dissolving the casein and albumen of the milk

by means of acids with the aid of heat, and allowing the melted fat to collect in a narrow tube where its volume can be measured with accuracy. For the solvent, a mixture of strong acetic, sulphuric, and hydrochloric acids in about the proportions by volume of 9, 5, and either 1 or 2, is used. Sulphate of soda is added when necessary to effect the solution of curd, especially in cases where the milk is not fresh. The operation is conducted in a glass tube about three fourths of an inch in diameter and 12 inches long, closed at the bottom and made narrow for about three inches near the middle where the fat rises and its proportion is read.

The apparatus and the methods of its use are described and discussed. The results of determinations of fat in both milk and cream by this as compared with the gravimetric method show a close agreement. The only considerable sources of error are said to be the incomplete solution of non-fatty portions of milk which is sour (with buttermilk the results have not been satisfactory) and errors in the graduation of the apparatus. To obviate the latter, arrangements have been made by which the station tests apparatus for buyers.

SWEET CREAM BUTTER, G. E. PATRICK, M. S. (pp. 317–320).—The making of butter from unripened cream has been long and extensively practiced in Denmark, and, to a limited extent, in this country. Interest in the subject has recently been revived here by the publication of a new method by Director J. A. Myers, of the West Virginia Station (See Hoard's Dairyman, November 29, 1889). Among his conclusions are, that the so-called ripening of cream is unnecessary and undesirable and that the preference for the flavor of ripened cream butter will disappear with the use of sweet cream butter. The new method is used with the centrifugal separator. Its novelty lies in the recovery of fat from the sweet buttermilk by the separator.

The objections commonly urged against making butter from sweet cream are (1) loss of fat in the buttermilk, (2) lack of proper flavor and aroma, and (3) alleged poor keeping qualities of the butter.

To test this method an arrangement was made by the station with Mr. J. N. Daniels, proprietor of the separator creamery at Dayton, Iowa, to furnish the station with samples of butter from sweet and ripened cream, which might be used to make a comparative test of the keeping quality of the two kinds. The sweet cream butter was made according to the directions given by Director Myers, and the ripened cream butter in the ordinary way. Three samples each were taken of separator milk, sweet buttermilk as it ran from the churn, and separated buttermilk, and four of ordinary sour buttermilk, for comparison. The samples were analyzed for fat in the station laboratory by the gravimetric method with the following average results: The separator milk yielded 0.42 per cent of fat; sweet buttermilk, 0.95; separated buttermilk, 0.39; sour buttermilk, 0.60. The low percentage of fat in the sweet buttermilk is surprising since ordinarily the loss of fat in buttermilk from

sweet cream is considerably greater than in this case. These results show that separation, leaving 0.42 per cent of fat in the new milk and 0.39 per cent in the sweet buttermilk, was not very close in either case, and that the "saving of butter fat by the sweet cream method over that by the ripened cream method was *in this experiment* only the difference between 0.60 and 0.39=0.21 per cent on the weight of the buttermilk." Assuming the loss of fat in the souring or ripening of cream to be so small that it may be neglected, the only gain in the butter fat saved in the new method as compared with the old *in this one trial* was one fifth of a pound to every 100 pounds of buttermilk, or, in a creamery producing daily 300 pounds of butter and 900 pounds of buttermilk, a saving of 1.9 pounds of butter fat, or say 2.1 pounds of butter. But of course no general conclusion can be drawn from a single trial.

Two tubs of ripened cream and sweet cream butter were stored side by side in a cellar. On opening the tubs after two months both samples were found to be in prime condition, and the sweet cream butter had a flavor approaching that of the ripened cream butter. They were left for comparison at successive intervals, "until one or the other sample shall deteriorate sensibly."

SUGAR-BEETS, G. E. PATRICK, M. S. (pp. 321–326).—This article gives the results of analyses of four varieties of sugar-beets grown at the station in 1888, two grown there in 1889, and one grown in Mercer County, Illinois, in 1889. As a report of these experiments is included in Bulletin No. 27 of the Division of Chemistry of this Department, a detailed account of them here is deemed unnecessary. The results for 1888 were encouraging, but those for 1889 were unfavorable, and further investigations are needed to determine whether the soil and climate of Iowa are adapted to the development of sugar in the beet. The station expects to repeat the experiment with imported seed of the best German varieties.

SORGHUM, G. E. PATRICK, M. S. (pp. 327–336).

Improvement by selection.—Under this head are given the results of experiments in 1889 aiming at the improvement of the sorghum plant as a sugar bearer. They are in continuation of those begun in 1888 and reported, with description of methods, in Bulletin No. 5 of this station (See Experiment Station Record, Vol. I, p. 44). The plan here followed is to select seed from individual stalks found by analysis to be richest in sugar and highest in purity of juice. In 1888 out of 180 stalks of Early Amber sorghum analyzed, ten were selected "whose juice showed an average purity of 73.4, with a mean sucrose content of 13.92 per cent; and ten more with an average purity of 73.7 and of 13.63 per cent sucrose." The seed from these selected canes was planted in 1889 in several plats for the purpose of securing a large number of stalks for analysis "even if selection of seed from all might not be found advisable." But the season was so unfavorable that only one hundred and seventy-five stalks were taken for analysis, and of these

only one hundred and forty-six proved to be sound, the rest having been injured by frost. "They were all from our 'best' patch of one hundred and forty Early Amber stalks, excepting six stalks of Early Orange, which were also from seed selected by analysis the previous year." The results of 1888 and 1889 are compared as follows:

	Season.	In cane juice.	On the juice.		
			Sucrose.	Purity.	Glucose.
EARLY AMBER.					
		Per cent.	Per cent.	Per cent.	Per cent.
Average of twenty stalks showing highest sucrose	1888	54.05	13.77	73.55	....
	1889	*50.18	14.26	76.45	....
Average of twenty stalks showing lowest sucrose	1888	58.42	9.28	59.40	....
	1889	†52.18	11.47	68.24	....
Averages for all individual canes analyzed	1888	54.66	12.10	....	§3.31
	1889	‡52.94	13.18	74.11	‖1.57
EARLY ORANGE.					
Fourteen stalks	1888	55.84	12.10	70.35	....
Six stalks	1889	55.87	13.35	75.60	....

*10 stalks. †9 stalks. ‡79 stalks. §32 stalks. ‖27 stalks.

It will be observed that there is a marked increase in the purity of the juice and in the per cent of sucrose, together with a considerable falling off in the per cent of glucose. It seems improbable that the decrease of glucose was due to the greater maturity of the cane in 1889. On the whole it seems reasonable to conclude that the quality of the cane has already been improved by these experiments.

Miscellaneous sorghum work.—Analyses are reported of five specimens each of Early Amber and Orange cane received from the president of the State Agricultural Society, and also eleven varieties grown from seed sent to the station by the United States Department of Agriculture. None of these varieties proved to be nearly as good as the Early Amber and Early Orange.

Sugar-house work.—Under this head are given chemical data relating to the experiments at the station in making sugar from sorghum, as reported in Bulletin No. 7 (See Experiment Station Record, Vol. I, p. 212). The results were not successful, partly because of the low content of sucrose in the cane used. The analyses given in this article enforce this statement. The results of analyses of cane chips and of mill juices as compared with diffusion juices are also stated.

Sorghum sirup adulterations.—The results of a polariscopic examination of a sample of sirup purchased in Iowa for genuine sorghum sirup and sent to the station for examination, are compared with those obtained from a specimen known to be genuine. The suspected sample apparently contained commercial glucose, the adulteration "probably amounting to fully one half of the dry solids of the sirup as sold." The station has undertaken to examine and report on any samples of sirup which may be sent by residents of the State.

ANNUAL REPORT, R. P. SPEER (pp. 337–340).—This includes a brief account of the lines of work carried on at the station in 1889, together with a financial statement.

Massachusetts State Station, Bulletin No. 36, March, 1890 (pp. 16).

METEOROLOGICAL SUMMARY (p. 1).—For the four months ending February 28, 1890.

SOME SUGGESTIONS ON THE ECONOMICAL IMPROVEMENT OF FARM LANDS, C. A. GOESSMANN, PH. D. (pp. 1–9).—The object of this article is "to discuss briefly some of the means of developing and economizing the manurial resources of the farm." The results of experiments by the station and of collateral observations of farm practice during a long period of years are utilized for the conclusions and advice given. In general, the farmer is advised to make a timely and thorough mechanical preparation of the soil; to select crops, as far as practicable, with reference to their tendency to economize existing natural resources of plant food; to make the most of all available home-made manure; to increase the supply of such manure by the wise use of concentrated feeding stuffs; and to supplement home-made manure with commercial fertilizers, as far as circumstances advise. Two special topics are discussed, viz., the selection and production of fodder crops, and the economical feeding of live stock.

Selection and production of fodder crops.—The decline in the original productiveness of farm lands, which has occurred in almost every country where the land has been long under cultivation, has been attributed mainly to—

(1) A gradual but serious reduction in the area occupied by forage crops, natural pastures and meadows; and (2) a marked decline in the annual yield of fodder upon large tracts of land but ill-suited for a permanent cultivation of grasses—the main reliance of fodder production at the time. A serious falling off in the annual yield of pastures and meadows is followed usually by a reduction in farm live stock, which in turn causes a falling off in the principal home resource of manurial matter. This chapter in the history of farm management has repeated itself in most countries. The unsatisfactory results of that system of farming finds still an abundant illustration in the present exhausted condition of a comparatively large area of farm lands in New England.

The scientific investigations of the past fifty years have not only determined the causes of this impoverishment of the soil, but "have also materially assisted, by field experiments and otherwise," in the renovation of worn-out lands. Among the means devised for this purpose none is more important than the "more liberal production of nutritious fodder crops."

The soundness of this advice is to-day fully demonstrated in the most successful agricultural regions of the world. An intensive system of cultivation has replaced in those localities the extensive one of preceding periods. Although the area under cultivation for the production of general farm crops has been reduced, the total value of the products of the farm has increased materially. The change has been gradual and the results are highly satisfactory.

In New England, meadow lands have been very often exhausted by a close rotation of mixed grasses and corn (maize) without a rational system of manuring. Both of the crops have taken large quantities of potash and considerable amounts of phosphoric acid from the soil and allowed other important constituents of plant food to accumulate in relative excess. "As the amount of available plant food contained in the soil represents largely the working capital of the farmer, it can not be otherwise but that the practice of allowing a part of it to lie idle must reduce the interest on the investment." The annual reports of this station contain detailed descriptions of experiments with fodder corn which show to what extent the supply of potash in the soils used had been exhausted. The introduction of new crops, especially the legumes, which utilize the nitrogen of the air and soil, and the growth of a greater variety of fodder plants—

> Enables us to meet better the differences in local conditions of climate and of soil, as well as the special wants of different branches of farm industry, * * * and taking this view of the question, the great and valuable family of leguminous plants, as clovers, vetches, lucern, serradella, peas, beans, lupines, etc., is, in a particular degree, well qualified for that purpose. They deserve, also, a decided recommendation in the interest of a wider range, for the introduction of economical systems of rotation, under various conditions of soil, and different requirements of markets. Most of these fodder plants have an extensive root system, and for this reason largely draw their plant food from the lower portion of the soil. The lands are consequently better fitted for the production of shallow-growing crops, as grains, etc. Large productions of fodder crops assist in the economical raising of general farm crops; although the area devoted to cultivation is reduced, the total yield of the land is usually more satisfactory.

Instances are cited of the success of the station in bringing up old, worn-out grass land by the use of leguminous forage plants.

A tabular record is given of the analyses of nineteen kinds of fodder crops raised at the station, some of them on a large scale, and for further details the reader is referred to the report of the station for 1889.

Economical feeding of live stock.—This insists upon the importance of selecting fodder materials that (1) furnish protein, fats, and carbohydrates in proportions fitted to the demands of animals; and that (2) are valuable for manure. Tables give estimates of the value of manurial ingredients of feeding stuffs per ton, and the cost of the digestible nitrogenous matter of the same materials per pound.

ANALYSES OF CORN SILAGE, C. A. GOESSMANN, PH. D. (pp. 10, 11).—A tabular record of analyses of six samples of silage from as many different varieties of corn, with brief notes on the manuring, mode of planting, stage of growth when harvested, yield per acre, mode of ensiling, and condition of silage when received at the laboratory.

COMMERCIAL FERTILIZERS, C. A. GOESSMANN, PH. D. (pp. 12–16).—This contains a table of the "trade values of fertilizing ingredients in raw materials and chemicals, 1890," and explanations of those values and of the conditions under which a fertilizer inspection is conducted by

the station, reprinted from Bulletin No. 33 of this station, an abstract of which is given in the Experiment Station Record, Vol. I, p. 79.

Michigan Station, Bulletin No. 57, March, 1890 (pp. 43).

VEGETABLES, TESTS OF VARIETIES AND METHODS OF CULTURE, L. R. TAFT, M. S.

Potatoes (pp. 4–25).—The land used in these experiments was a heavy, sandy loam with a clay subsoil, and was thought to be quite uniform. It was marked off with 24 rows, 3½ feet apart, the trenches being 5 inches deep. Sections 25 feet in length were then made in each row, three of which were used for variety tests, and the others for experiments with different methods of planting, fertilizing, etc. In many cases duplicate and even triplicate tests were made. The experiments are to be continued through a series of years.

Tests of varieties (pp. 4–12).—Seventy-five varieties were grown, including many standard and some new kinds. A row 25 feet long was given to each variety. Observations as to time of ripening and blossoming, ripening and yield of marketable and unmarketable potatoes, size and number of tubers, etc., are recorded in a table, and brief descriptive notes are given for each variety.

Methods of culture, etc. (pp. 13–25).—The experiments were to get light on the following questions: (1) Shall the seed end be thrown away? (2) How much seed shall we use, and how shall we cut potatoes? (3) How shall we plant them? (4) How deep shall we plant them? (5) What is the best way to apply manure? (6) What causes scab, and how can it be prevented?

1. *Seed ends for planting.*—Twenty-five tubers of each of three varieties were cut transversely into stem, middle, and end pieces, and planted in rows side by side. The results are recorded in tables. "Contrary to a common belief that tubers grown from the seed end are smaller, the yield from the seed end averaged about the same as that from the middle or the stem end," and the weight of the small tubers from the seed end was only 70 per cent as great as that of those from the stem end, and only about 55 per cent as great as that of those from the middle pieces.

2. *Quantity of seed.—Number of eyes.*—"Various experiments have been tried to ascertain the quantity of seed required for the best results, but contradictory conclusions have been reached. One cause for this may be found in what may be termed the individuality of the tubers. To counteract this in a measure, the pieces were taken, as in the experiment to learn the value of the seed end, from the same potatoes. This experiment was also carried out in triplicate, three different varieties being used.

"Twenty-five medium sized potatoes of each were selected and cut lengthwise. One half from each tuber was used and the remaining pieces were halved, and so on until we had halves, quarters, eighths and

single eyes. Each variety was planted by itself in the above order, and then a row of whole tubers was planted."

Details of the experiment are given in tables. The average results of the trials with the three varieties were most favorable for the halves, as shown in the following summary, in which the yields are calculated per acre:

Size of seed.	Amount of seed.	Yield per acre.	Net yield in excess of seed.	Net gain from using halves.
		Bush.	*Bush.*	*Bush.*
Halves	20 bush., 19 lbs	317	297	....
Quarters	9 bush , 54 lbs	254	244	53
Eighths	5 bush , 44 lbs	221	215	82
Single eyes	4 bush , 10 lbs	178	174	133
Whole tubers	41 bush., 40 lbs	293	251	46

In another experiment, but in this case a single trial, *i. e.* with one variety, whole potatoes of different sizes were compared with halves and single eyes, as indicated in the following summary, in which the results are reckoned per acre:

	Quantity of seed.	Market-able.	Small.
	Bush.	*Bush*	*Bush.*
Whole tubers weighing 4⅞ ounces	60	370	62½
Whole tubers weighing 3⅛ ounces	44	361	31¾
Half tubers weighing 1¾ ounces	22	433	31
Whole tubers weighing 1¾ ounces	22	349⅓	45
Half tubers weighing ⅞ ounces	11	305½	44
Single eye, cut deep	....	173½	21⅛

"We have here a repetition of the first experiment so far as the results were concerned, a half tuber weighing 1¾ oz., or at the rate of 22 bushels per acre, giving the best results. Whole tubers at the rate of 44 bushels per acre gave a larger yield than whole ones at the rate of 22 bushels, but the gain in yield was not equal to the increased amount of seed. It would also seem that the halves of medium sized potatoes are better than whole ones of the same or even of a much larger size, and are by far preferable to strong eyes from the same potato; while, as shown by the previous experiment, the eighths and quarters, containing from two to four eyes each, are also much less productive than larger pieces.

"It is often claimed that a strong eye, planted in good soil, will yield as many marketable potatoes as if a half or whole tuber was used. The soil used this year was far better than the average potato land, and it was well prepared for the crop. If they will do well anywhere they certainly ought to have done so in this case, especially as the distance, one foot, between the pieces was against the large tubers.

"From the time the plants appeared above ground there was a difference in favor of the large pieces, the height and vigor of the plants

gradually increasing from the single eye up to the whole large potato; and when we came to dig and weigh the product we found an increase in about the same ratio."

3 and 5. *Methods of planting.—Effects of fertilizers.*—Seven methods of planting were tested on as many plats, each containing one hundred hills.

Plat 1. A 6-inch furrow was two thirds filled with soil, the seed was then dropped and covered, and when the plants were well up the space between the rows was filled with strawy manure to the depth of 2 inches.

Plat 2. The furrow was half filled with fine manure, the seed was dropped on this and covered 2 inches. Level culture was given.

Plat 3. The furrow was filled so that it was three inches deep. One bushel of unleached wood ashes was scattered in the bottom, and the seed was then dropped and covered 2 inches. Level culture.

Plat 4. The method used here may be called very properly the "Rural Trench System," as it was first brought to the notice of the public by the Rural New Yorker. A mixture of 5 pounds of dissolved bone (at the rate of 625 pounds per acre), 3 pounds of sulphate of potash (375 pounds per acre), and 2 pounds of sulphate of ammonia (250 pounds per acre), was scattered in the bottom of the 6-inch trench. With a spading fork it was thoroughly mixed with the soil to the depth of 8 inches and the width of 12 inches. The seed was then dropped and covered 2 inches. Level culture.

Plat 5. The only difference between this plat and the last was that the fertilizer was not applied until the seed had been planted and covered 1 inch. It was then scattered on and 1 inch of soil was placed upon it. Level culture.

Plat 6. Exactly like plat 5, except that the rows were hilled when half grown.

Plat 7. The seed was dropped in the bottom of the 6-inch trench. It was covered with 1 inch of soil and the trench was filled with strawy manure.

The results, which are stated in a table, may be summarized as follows: (1) When fertilizers were used, slightly better results were obtained when they were applied over the seed; (2) when fertilizers were used, the best results were from level culture; (3) with wood ashes at the rate of 125 bushels per acre, the yield was larger than with 1,250 pounds of fertilizers. (This is an important matter in Michigan, where, in many localities, wood ashes can be had for the hauling). (4) The results with stable manure were better than with either ashes or commercial fertilizers. (5) The results with manure placed between the rows as a mulch were better than when it was used either over or under the seed.

4. *Depth of planting.*—The soil and season have much to do with the answer to the question, What is the best depth to plant? and no one trial can give an answer that will be correct in all cases.

With a compact soil and a wet spring a shallow covering is generally considered best, and our results this year seem to bear out this belief. Duplicate rows were planted at depths of 1, 2, 3, 4, and 5 inches in the following manner: For the one-inch covering the trenches were filled with soil within 1 inch of the surface; the seed was then dropped and covered 1 inch. For the two-inch covering the trenches were filled within 2 inches of the surface, and so on for the other depths.

The results stated in a table show but little difference in the yields of rows covered 1 and 2 inches deep, but where the coverings were 3, 4, and 5 inches the yields were considerably less.

"With an open, well-drained soil we have obtained best results by planting in trenches 5 inches deep and covering 2 inches."

6. *Potato scab.*—To get light bearing upon the theory that scab is produced by the action of substances in the soil which cause mechanical or other injury to the tuber, twenty rows, each 2½ rods long, were treated before planting with hyposulphite of soda, sulphate of iron, sulphur, sulphate of potash, or sulphate of potash and ground bone, and the results compared with those from four untreated rows. Two varieties of potatoes were used, each in twelve rows. The results as reported show a large difference in the number of scabby tubers in the two varieties, and a considerable increase of scab where the hyposulphite of soda was used. This seems to accord with the theory that scab is caused by "irritating" substances in the soil.

Tomatoes (pp. 25–32).—*Test of varieties.*—A tabular record and brief descriptive notes for forty-two varieties. In most cases twelve plants of a variety were used.

"*Summary:* For earlier varieties we need not look beyond Earliest (Vaughan) and King of the Earlies (Ely). Prelude is too small. Following these are Advance and Hathaway's Excelsior. Of large, smooth red kinds there is little choice between Perfection, Paragon, Volunteer, Bay State, Haines' No. 64, Nichol's Stone, Matchless, and a number of others."

"Ignotum is with us still the most solid, and largest smooth tomato. Out of five hundred plants only one sported. Red Mikado is a red and regular form of Mikado. Of pink or purple varieties, Acme, Beauty, and Mikado. Shah is a yellow variety of Mikado parentage."

Effect of using seed from first ripe fruit.—In an experiment reported in Bulletin No. 48 of this station, there was a gain of over 300 per cent in the weight of the fruit from using seed from first ripe fruit in the case of the angular varieties tested, but an apparent loss of 150 per cent in the case of the smooth varieties. The experiment was repeated in 1889 with 36 varieties, equally divided between the angular and the smooth kinds. The results favored the seed from first ripe fruits to a small extent in the case of the angular varieties, but were unfavorable to a larger degree in the case of the smooth varieties.

"From the trials of the past two years it would seem there is little to be gained by selecting seed from the first fruits to ripen. It is true that during both years there is on the average a slight apparent gain from such selection of angular sorts, but eight of the eighteen varieties show a loss from such selection, and we can only regard as accidental the fact that in the angular sorts the average shows a gain and in the smooth sorts a loss where such selection is made."

Does it pay to start tomatoes under glass?—To get light on this question

"strong plants of three varieties were put out, and adjoining them small plants from seed boxes were transplanted, and beyond these, seeds of the same varieties were planted in the open ground. All started off well but when the frost killed the vines no ripe fruits had been obtained from either lot of seedlings, and the fruits on the plants from seed boxes were about half way between those on the strong plants and on the open-ground seedlings."

Wire trellis for tomatoes.—An inexpensive wire trellis, devised and successfully used at the station, is described.

Beets (p. 32).—Tabulated notes on thirteen varieties. Early Eclipse, Extra Early Egyptian, Bassano, Early Crimson, and Victoria are especially commended.

Cabbages (pp. 33–36).—A tabulated record for thirty-six varieties, including notes on germination tests (percentages of seeds which germinated) with seed-testing apparatus and in seed boxes. The results obtained in the germination tests compared with the notes on the appearance of the young plants in the seed boxes show the desirability of having fresh and pure seed.

"Where the tester shows over 90 per cent and the seed box over 80 per cent [germinated] the plants are 'strong and even,' but below these figures we find them 'weak and uneven;' below 60 per cent they are 'very weak and uneven.' Out of twenty-three varieties sown in the forcing-house, ten gave plants strong and even, with a vegetation of 84 per cent, while thirteen were weak and uneven, with a showing of only 50 per cent. In most of the varieties of the first group all the plants appeared at once, but in nearly all the others there seemed to be at least two or three vegetations."

The author's experience with cabbage seed compared with what has been noticed with other seed for a number of years, leads him to believe that it is a common practice for seedsmen to mix their old stock with the new seed.

Among early varieties Landreth's Earliest, Everitt's Earliest, New Express, Everitt, Early Etampes, and Early Jersey Wakefield are commended. "Closely following these varieties come Henderson's Early Summer, Early Summer Flat Head, New Peerless, New Cassell, and Succession. * * * Two weeks later the Vandergaw and Reedland Early Drumhead matured, both of which made a good showing. * * * Of the later kinds, Bloomsdale Late Flat Dutch, Chase's Excelsior, Genuine Surehead, Joseph Mason, Large Late Flat Dutch, and Louisville Drumhead, all gave satisfactory results."

Cauliflower (pp. 36, 37).—Tabulated notes on ten varieties.

Sweet-corn (pp. 37, 38).—Tabulated notes on twenty-eight varieties.

Lettuce (pp. 38, 39).—Tabulated notes on thirty-six varieties.

Peas (pp. 40, 41).—Tabulated notes on thirty-six varieties. The varieties which gave the best results in 1889 were, *Early*—Philadelphia Extra Early, Bergen Fleetwing, Alaska, Rural New Yorker, First

and Best, and Maud S; *medium*—Pride of the Market, Market Garden, and Dr. McLean.

Radishes (pp. 42, 43).—Brief notes on twenty-two varieties.

Michigan Station, Bulletin No. 58, March 1890 (pp. 13).

INSECTICIDES, A. J. COOK, M. S.—The methods of preparation and application of the following insecticides are stated, together with illustrations of their usefulness: The arsenites (Paris green and London purple), Bordeaux mixture, carbolized plaster, kerosene emulsion, buhach or California pyrethrum, tobacco decoction, kerosene ointment, carbolic acid emulsion, white hellebore, bisulphide of carbon, and cyanogen (cyanide of potassium).

Michigan Station, Bulletin No. 59, April, 1890 (pp. 42).

LIST OF FRUITS FOR MICHIGAN, L. R. TAFT, M. S. (pp. 3–26).—In this article are condensed the replies received from a circular of inquiry sent by the station to one hundred leading fruit growers in the State, the object being to secure accurate information regarding the varieties successfully grown in different localities. In several instances the list returned to the station had been previously discussed and approved by the county horticultural societies. "The returns are classified into five groups, giving fruit lists for Southern, Central, and Northern Michigan, the Southern and Northern Lake Shore." Notes on the size, shape, color, quality, and uses of the several varieties are added from the State Horticultural Society's fruit list for 1888. For a more extended list of large fruits grown in Michigan the reader is referred to that publication, and for a list of small fruits, to Bulletin No. 55 of the station. The list and notes in this article are for 36 varieties of apples, 14 of pears, 16 of plums, 26 of peaches, 14 of cherries, 11 of grapes, 8 of currants, 4 of gooseberries, 14 of raspberries, 6 of blackberries, and 16 of strawberries.

APPLE SCAB (pp. 27–42).—This includes brief descriptive notes on the fungus of apple scab (*Fusicladium dendriticum*), by B. T. Galloway of this Department, and a report on experiments made in 1889 in the treatment of apple scab in Michigan, by L. R. Taft. The experiments were performed in co-operation with the Section of Vegetable Pathology, of this Department, and the report is reprinted from Bulletin No. 11 of that Section (pp. 30–38). A brief summary of these experiments may also be found in the Journal of Mycology for December, 1889.

Minnesota Station, Bulletin No. 10, March, 1890 (pp. 17).

ONIONS ON LAND PLOWED AND UNPLOWED, S. B. GREEN, B. S (pp. 67–69).—The results of tests in the wet season of 1888 and the dry season of 1889 with onions on clayey loam, which was harrowed but not

plowed before planting, as compared with those on the same land plowed and harrowed, were decidedly in favor of the former method. The average yield per acre for the two years on the plowed land was 431 bushels, while that on the harrowed land was 500 bushels.

Brief notes are also given for six new varieties of onions.

CABBAGES, S. B. GREEN, B. S. (pp. 69, 70).—Tabulated notes on tests of twenty-eight varieties.

LONDON PURPLE FOR THE CURCULIO ON NATIVE PLUMS, S. B. GREEN, B. S. (pp. 71, 72).—An account of experiments in spraying with London purple. The results indicated that the native plums may be benefited by this treatment as well as the European varieties.

BAGGING GRAPES, S. B. GREEN, B. S. (pp. 72, 73).—The usefulness and expense of protecting grapes with bags are considered, as well as the times and methods of putting on the bags. Experiments with the Delaware, Early Victor, and Brighton grapes are reported. "The fruit was bagged with paper bags when about the size of small peas. At the harvest the bagged grapes were better in every case than those not bagged, but the most marked difference was with the Brighton, the bunches of which were clean, perfectly colored, and the sweetest grape I have ever eaten. Those exposed were not so good in any way, being very dusty, and uneven in ripening. In our previous trials with Concord and Worden, and some other varieties, the result has been uniformly in favor of the use of bags as a covering."

ROLLINGSTONE PLUM, S. B. GREEN, B. S. (p. 73, illustrated).—A brief account of this variety of plum, illustrated with cuts showing sections of the fruit. This variety is considered by the author as "perfectly hardy with us (in Minnesota), and a very excellent plum, of mild but rich flavor, and a valuable addition to our list of hardy plums."

POTATOES AT DIFFERENT DEPTHS, S. B. GREEN, B. S. (pp. 73, 74).—A brief account of an experiment with Burbank Seedling potatoes (cut to two eyes), on a rich, light, clayey loam, in the dry season of 1889. Planting on the surface and covering 2 inches deep was compared with planting in furrows 3, 6, and 8 inches deep and covering to the depth of the furrow. The trials were made in four rows 3 feet apart and each 100 feet long, one row being used for each trial. The yields per acre were 216 bushels from surface planting, 227 at 3 inches deep, 297 bushels at 6 inches, and 328 bushels at 8 inches deep. In a wet season the author thinks the results might be reversed.

OAK CATERPILLARS, O. LUGGER, PH. D. (pp. 75–84, illustrated).—Accounts are given of the following insects which infest the native species of oaks in Minnesota: *Anisota senatoria*, Sm. Ab.; *Anisota virginiensis*, Dru.; *Datana ministra*, Dru.; *Edema albifrons*, Sm. Ab.; *Janassa lignicolor*, Walk.; *Perophora melsheimeri*, Harr.; *Apatela brumosa*, Guen.; *Gastropacha americana*, Harr. These insects are figured in a number of cuts, some of which are from original drawings.

New Hampshire Station, Bulletin No. 9, February, 1890 (pp. 16).

EFFECT OF FOOD UPON THE QUALITY OF MILK, G. H. WHITCHER, B. S.—This is a popular article, including only brief outlines of experiments made at the station. The nature and composition of milk are explained and partial results given of analyses at the station of the milk of four cows of each of four breeds—Jersey, Ayrshire, Holstein and Shorthorn.

It is urged that the quality and composition of the milk are affected by: (1) Breed; (2) individual characteristics; (3) period of lactation, *i. e.* the time since calving; (4) time of milking, morning *vs.* night; (5) frequency of milking; (6) portion of milking, *i. e.* the first drawn *vs.* strippings. It may fairly be claimed that *all of these are independent of the food.*

Breed and individual characteristics.—The fat of the Jersey milk ranged from 4.34 to 6.06 per cent, average 5.12 per cent; of Ayrshire, from 3.81 to 4.55, average 4.28; Holstein, from 2.84 to 3.54, average 3.13; Shorthorn, from 3.50 to 4.15, average 3.86. The cows had been fed practically alike. Analyses are cited in support of the statement that "the average differences in the fat percentage of their milk are due to the breed, not to the feed." That one of the Jerseys would make a pound of butter from 15 pounds of milk while another would yield only a pound of butter for 21 pounds of milk, and this on the same kind of food, is one of numerous illustrations cited of what is urged as a general principle, that "breed and individual characteristics are the two great factors that determine the richness of milk."

Period of lactation.—As illustrations of the influence of the period of lactation on the quality of the milk, it is stated that the milk of one cow contained 3.5 per cent of fat in November and December, 1888, and 3.9 per cent in May, 1889, on the same food; and on pasture feed 4.16 per cent in August and 4.23 per cent in September; while the milk of another cow averaged 3.6 per cent in November and December, 1888, 3.9 per cent in April, 1889, and 4.4 per cent in May.

Morning's vs. night's milk.—In the case of three cows whose milk was analyzed night and morning daily for a full year, "the *morning's* milk was richer than the *night's* milk during the time that the cows were on pasture feed, but when the same cows were put into the barn the reverse was true; that is, the night's milk was the richer."

The difference between morning and night's milk is quite marked; thus, during June, July, and August a Jersey cow gave milk which averaged as follows:

Morning's milk, 6.26 per cent.
Night's milk, 5.75 per cent. } Average, 6.01 per cent.

Difference, 0.51 per cent in favor of morning's milk.

The same cow during January, February, and March gave:

Morning's milk, 5.81 per cent.
Night's milk, 6.30 per cent. } Average, 6.05 per cent.

Difference, 0.49 per cent in favor of night's milk.

Other cows gave like results, not so marked.

No positive explanation is offered for this difference, but it is suggested that the exercise involved in grazing over a comparatively large pasture during the heat of the day, or both the exercise and the heat together, may tend to diminish the richness of the milk secreted during the day.

Frequency of milking.—The effect during a very short time of very frequent milking was observed with two cows, which were milked every hour—one, a Shorthorn, for twenty-four hours; the other, a Jersey, for seventy-two hours.

"At the time of the commencement of the experiment the Shorthorn cow was giving 14.25 pounds of milk daily, in which there was 3.89 per cent of fat, or 0.554 pounds of actual fat daily. In twenty-four hours of hourly milking she produced 16.25 pounds of milk, in which was 5.27 per cent of fat, or of total fat 0.856 pounds; an increase of 54.5 per cent in the total fat in twenty-four hours.

"The Jersey produced, previous to the experiment, 10.07 pounds, in which was 6.02 per cent of fat, or 0.606 pounds. The test was for seventy-two hours, and I will divide it into three daily periods:

	Amount of milk	Fat.	Absolute fat per day.	Gain of total fat.
	Pounds	*Per cent.*	*Pounds*	*Per cent.*
First day	10.5	7.05	.743	22¾
Second day	10.6	5.94	.630	4
Third day	10.9	5.74	.626	3½
Total	32.0	18.73	19.99	
Average	10.6	6.24	.666	10

It is noticeable that in the case in which the experiment was continued three days the gain in the percentage of fat was confined to the first day, and that the gain in total fat was largest the first day, and very little the second and third days.

First milking vs. strippings.—In illustration of the well-known fact that the last portion of a milking is richer than the first, a case is cited in which the first 4 ounces of milk drawn from a Shorthorn cow yielded 1.36 per cent of fat, and the last 4 ounces 8.04 per cent.

Effect of food upon percentages of water and fat in milk.—Pasture grass vs. dry fodder.—Silage.—"Does watery food make watery milk?" In the case of a whole herd, numbering about 20 cows, going from barn feed to pasture grass in May (kind and amount of dry feed, lengths of periods of dry feeding and pasture feeding, on which estimates are made, total and daily yields and composition of milk not stated), the yield of milk increased with change to pasture feed, while the amount necessary to produce a pound of butter decreased by 1.5 pounds, indicating that with the succulent food there was more and richer milk. The changes in the quantity and quality of milk in the case of two

cows—one Shorthorn and one Jersey—on changing from dry feed to pasture are also reported. The daily milk yield of both cows increased, that of the Jersey 2.3 pounds, and of the Shorthorn 2 pounds, while the percentages of solid and of fat remained nearly the same. In the Jersey milk the total solids increased 0.2 per cent, the increase being in the fat, while the casein and sugar remained the same. In the milk of the Shorthorn cow the fat increased 0.05 per cent and the casein 0.15 per cent, while the sugar fell off 0.2 per cent; the percentages of total solids remaining unchanged.

The substitution of silage for dry fodder has by some writers been characterized as a polite way to water milk. The results of experiments with two Shorthorn cows which had been changed from dry fodder to silage, are very briefly outlined. They gave no evidence that the milk was made watery. The variations in composition were very small, but so far as they went they implied a tendency of silage to make more and richer milk than dry fodder, thus corresponding with results cited for pasture feed.

Nutritive ratio and composition of milk.—Eight cows in four lots, A, B, C, and D, of two cows each, of different breeds, were fed with different rations. To a mixture of 5½ pounds of hay, 44 pounds of silage, and 3 pounds of middlings were added 6 pounds of "gluten" in one ration, making the ratio of protein to non-protein (fat, starch, etc) 1 : 5.2 which nearly accords with the German [Wolff's] standard, 1 : 5.4 for milch cows. In another ration the gluten was replaced by an equal weight (6 pounds) of corn meal, making the ratio 1 : 9. These were fed in one series of experiments to two lots (A and B). Other rations with ratios of 1 : 5.6 as compared with 1 : 8 were fed in another series to the two other lots (C and D). "The lots were alternated, being fed two weeks for each period." In other words, nitrogenous (narrow) rations were compared with "starchy" (wider) rations in two series of experiments. In one series the comparison was between ratios of 1 : 5.2 and 1 : 9, in the other it was between ratios of 1 : 5.6 and 1 : 8. In each series two lots of cows were fed for fourteen days with the wider, and for fourteen days with the narrower ration. With a fifth lot (G) of two cows silage was compared with hay. Details are not given as to analyses of food materials, preliminary and transition feeding periods, and ways in which lots were "alternated" to eliminate the influence of the period of lactation. It was argued that if the character of the food exerts a marked effect upon the quality of the milk "these rations ought to make themselves felt." As regards the quantity of milk, there was in the average of each of the four trials a smaller yield with the wider ration, the loss being from 8 to 10 per cent. As regards the percentage composition of the milk, there was with the wider ration, in the percentage of total solids, a gain in each of the four cases (*i. e.* each of the four lots of cows) of from 0.03 to 0.34 per cent; in the fats, a gain in one case of 0.29, and in three cases a loss of from 0.06 to 0.53

per cent; in the casein, a gain in three cases of 0.02 to 0.06 per cent and a loss in one case of 0.09 per cent; in milk sugar, a gain of 0.4 per cent in two cases and a loss of 0.02 and 0.03 per cent in the other two cases. Taking the average of the four lots of cows when the narrow ration was changed to a wide one by substituting corn meal in the place of gluten, pound for pound, the yields of milk per cow per day were with gluten 22.07 pounds, with corn meal 20.2 pounds—loss 1.87 pounds. The percentages of total solids increased 0.16, of casein 0.06, and of sugar 0.19, while the percentage of fat decreased 0.09. Taking into account both amount and composition of the milk as affected by the change from the wider to the narrower ration, the total amount of butter fat in the milk per day increased very slightly in one case and decreased in three cases. The average amount in the milk per cow per day was with the more nitrogenous ration 0.977 pounds and with the less nitrogenous 0.875 pounds, making a loss of 0.102 pounds with the wider ration. "The average cost of the corn meal rations was $0.161, of the gluten meal $0.171, per day. And with the eight cows under consideration the cost of milk per cwt., with the gluten, was $0.774; with the corn meal, $0.797; a difference of $0.023 per cent in favor of gluten." To recapitulate briefly, in these experiments when the nitrogen of the food was diminished and its non-nitrogenous ingredients increased the total milk yield was decreased. The percentage of total solids in the milk increased in every case; the percentage of casein in the milk was increased in three trials out of four and in the average of all four; the percentage of fat and the total amount of fat in the milk decreased in the same three cases out of four and in the average of all. It should be added, however, that the change in composition of the milk was in some cases so small as to approach the limits of error of analysis.

Effect of narrow and wide nutritive ratios on the ratio of casein to fat in milk.—A number of further observations on the effect of food upon the ratio of casein to fat in milk are given. A Jersey and two Shorthorn cows received rations with nutritive ratios varying from 1:5.5 to 1:12.3 during periods of fourteen days each. In the results obtained in 29 periods there was in general somewhat more casein in proportion to the fat with the non-nitrogenous than with the nitrogenous food. In brief, so far as these results are concerned, the effect of reducing the proportion of protein and increasing the non-nitrogenous constituents of the food was to increase rather than diminish the ratio of casein to fat. It is to be noted, however, that the range in the rations fed was from what is commonly regarded as normal to a large excess of carbohydrates. The (German) standard for milch cows, which is commonly quoted, has a nutritive ratio of 1:5.4, which is about that of good pasture grass. The effects of excess of protein in the food were not tested.

"*Butter and cheese cows.*"—Attention is called to the error in supposing that milk that is poor in fat is rich in casein or that "poor butter cows are great cheese cows." In general a high percentage of fat and

a high percentage of casein go together, and a milk rich in fat is not only a good milk for butter but also a good milk for cheese, while the reverse is also true. Results of later physiological inquiry regarding the function of the milk glands and the production of milk are cited in support of this view, which the writer holds in common with many others.

The general inference drawn from the above experiments, which are regarded by the author "as fairly representative of others," is "that a given animal by heredity is so constituted that she will give a milk of a certain average composition; by judicious or injudicious feeding the amount of milk daily may be very largely varied, but the quality (composition) of the product will be chiefly determined by the individuality of the cow. * * * Slight variations are always cropping out whether we change the food or not, but changes of per cent of fat of any considerable amount do not appear to trace to food influence, so long as the food is reasonably well proportioned and sufficient in quantity. *Quantity* is the result of food influence; quality is the result of the make-up of the animal."

Oregon Station, Bulletin No. 4, January, 1890 (pp. 35).

NOTES ON FARM CROPS, E. GRIMM, B. S. (pp. 3–18).—Plat experiments with grasses, clovers, forage plants, and cereals were begun in February, 1889, on about 12 acres of tile-drained land, which had previously been used for a pasture for six or seven years. There were in all 112 plats—67 for grasses, 10 for clovers, 7 for forage plants, 13 for wheat, and 15 for oats. Twenty-six plats with grasses and 5 with clovers on "white land" were one fortieth acre each; the dimensions of the other plats are not given. Brief notes are given on rescue grass (*Bromus schraderi*), meadow fescue (*Festuca pratensis*), tall fescue (*Festuca elatior*), meadow foxtail grass (*Alopecurus pratensis*), awnless brome grass (*Bromus inermis*), meadow soft or mesquite grass (*Holcus lanatus*), orchard grass (*Dactylis glomerata*), tall oat grass (*Arrhenatherum avenaceum*), rye grasses (*Lolium perenne* and *L. italicum*), timothy (*Phleum pratense*), Bermuda grass (*Cynodon dactylon*), and Texas blue-grass (*Poa arachnifera*). The experiments with clovers included red, alsike, and crimson (*Trifolium incarnatum*). It has been claimed that clovers can not be successfully grown in the section where the station is located, but the author is convinced that "failure to secure a stand of clover in the Willamette Valley means, in most cases, poorly drained and cultivated soil, as no plant does better than the clovers in this section. This is evidenced by the growth of our native clovers, such as *Trifolium microdon*, *T. involucratum*, and others, which grow to the height of 2½ feet in our fields. Indeed there is every evidence of this being a most excellent clover country, and with due care in the preparation of the land no more trouble need be experienced here in growing this most valuable crop than in the most favored localities."

A portion of the land on which the experiments with grasses and clovers were made is what is locally known as "white land." By this term is meant a heavy clay of whitish color, usually covered or saturated with water during the winter and spring months, destitute of natural drainage, and generally the lowest portion of an extensive tract of comparatively level country. It yields a light pasturage of native grasses where undisturbed by the plow. There is a large amount of this land in the Willamette Valley which is giving but small returns to the farmers who attempt to cultivate it. It is considered of inferior quality for farm or pasture land. Wheat and oats do not fill well on this land and the grasses which grow upon it are some varieties of *Agrostis* (Redtop), *Aira* (Hair-grass), and *Alopecurus* (Foxtail), which are of an inferior quality and afford but a scant pasturage for stock. The great trouble with this land is excessive moisture, and the remedy is thorough drainage and careful cultivation. The author feels confident that with proper management, grasses, clovers, and other forage plants can be profitably grown on this land.

Then follow brief notes of experiments with teosinte (*Euchlæna luxurians*), spurry, serradella, *Madia sativa*, Johnson grass (*Sorghum halepense*), sainfoin (*Onobrychis sativa*), and spring vetches (*Vicia sativa*), and a list of the fifty-three species of grasses, clovers, and other forage plants grown at the station. The large extent of the area in Oregon which must be used for pasturage, if at all, makes the study of forage plants a very important one for this station.

Tests of varieties.—Notes are given on 13 varieties of wheat, 15 of oats, 4 of buckwheat, 41 of corn, 7? of potatoes, 24 of sorghum, 4 of ruta-bagas, 5 of mangels, 3 of carrots, and 2 of sugar-beets.

HORTICULTURAL NOTES, E. R. LAKE, M. S. (pp. 19–27).—This includes a list of vegetables planted in 1889, with brief notes on a few varieties of beets, cabbages, carrots, cauliflowers, celery, cucumbers, peas, radishes, tomatoes, and turnips; a list of the deciduous trees and shrubs, evergreens, vines and climbers, and house plants growing at the station; and a list of proposed plantings in 1890 of small and orchard fruits, and nut-trees. For lists of the small and orchard fruits previously grown at the station, reference is made to Bulletin No. 2 of this station.

CHEMICAL ANALYSES, P. H. IRISH, PH. D., AND W. D. BIGELOW, B. A. (pp. 28–35).—Analyses of specimens of clay, rock, mineral water, and wheat are reported. An apparatus used at the station in the determination of fat in vegetable substances is described and illustrated.

Oregon Station, Bulletin No. 5, April, 1890 (p. 31).

ENTOMOLOGICAL NOTES, F. L. WASHBURN, B. A. (pp. 3–23, illustrated).—Brief descriptive notes, with suggestions as to remedies for the codling moth, woolly aphis, green aphis, pear-tree slug, peach-tree borer, San José scale, flat-headed apple-tree borer, gooseberry fruit

worm, currant borer, flea beetle, pea weevil, strawberry crown-borer, cut-worm, and grain beetle (*Silvanus surinamensis*). There is also a preliminary account of experiments at the station with various insecticides for the grain beetle. Gum camphor, kerosene, kerosene vapor, the fumes and a liquid preparation of bisulphide of carbon, and the vapor of crude carbolic acid were the principal remedies tested. Bisulphide of carbon proved the most effective, but there are difficulties in the way of its use in granaries. The experiments will be continued.

GOPHERS AND RABBITS, F. L. WASHBURN, B. A. (pp. 24–29, illustrated).—Brief notes on the pocket and gray gopher and the jack rabbit, with suggestions as to means for their repression.

ANALYSIS OF BONE MEAL, P. H. IRISH, PH. D., AND W. D. BIGELOW, B. A. (pp. 30, 31).—Tabulated notes on chemical and mechanical analyses of two samples of bone meal.

The need of a fertilizer inspection in this State is urged, and the conditions are stated under which the station will examine samples of commercial fertilizers sent to it for that purpose.

Tennessee Station, Bulletin Vol. III, No. 1, January, 1890 (pp. 24).

EXPERIMENTS IN GROWING POTATOES, C. S. PLUMB, B. S.—The experiments with potatoes at this station in 1889 are discussed in this bulletin under the following heads: (*a*) Concerning the influence of the amount of seed tuber planted upon the resulting crop of Irish potatoes; (b) trial of the Rural New Yorker trench system of potato culture; (*c*) tests of varieties of Irish potatoes; (*d*) early *vs.* late culture for sweet-potatoes. The soil used in all the experiments was a clay loam with a heavy clay subsoil.

Influence of the amount of seed tuber planted upon the resulting crop.—Under this head three different experiments with Early Rose potatoes are described.

1. *Comparison of whole tubers of different weights for seed.*—Eight different lots of whole tubers of Early Rose potatoes were selected; each lot, with one exception, consisting of 100 tubers. Each potato of each lot was weighed on a Fairbanks silk scale, and each lot was planted in a row by itself, the rows being 3½ feet apart and the tubers 2 feet apart in the row, with the exception of one row, in which they were 3 feet apart. A table gives for each row the weight and number of tubers planted, the date of vegetation, blooming, and ripening, number of tubers vegetated, and the height of plants June 20. From the data reported it appears that: (1) The *largest* tubers bloomed first and produced the highest (and also largest) growth of plants; (2) the *smallest* tubers bloomed last and produced the lowest (and smallest) plants, and ripened one day earlier than the largest; (3) large size apparently favored earliness of bloom, height, and size of plant, and, to a certain extent, delayed ripening; (4) plants from tubers weighing from 4 to 8 ounces ripened earlier than those from tubers of greater or lesser weights.

Two other tables give the yield of merchantable and unmerchantable potatoes in each row, and the average yield per hill for the different lots. The highest yield of merchantable potatoes from 100 tubers was 623 potatoes weighing 102¾ pounds from tubers averaging 8 to 10 ounces; the lowest was 363 potatoes weighing 62 pounds from tubers averaging 1 to 2 ounces. The highest average yield per hill of merchantable potatoes was from seed which weighed from 8 to 14 ounces per tuber. From seed tubers weighing 1 to 2 ounces the average yield was only 3.6 merchantable tubers weighing 10 ounces. In general the productiveness per hill was greater with the largest tubers and decreased quite constantly with a decrease of weight in the seed. The relation of the size of the seed tuber to the amount of the crop is illustrated by a diagram. Calculations are reported which show that while 81 bushels of 10 to 12-ounce tubers would be required to plant an acre, at the rate employed in this experiment only 11 bushels of 1 to 2-ounce tubers would be required for the same area.

The table herewith gives calculated results per acre, merchantable and unmerchantable potatoes being classed together in the total yield.

Estimated yields, cost of seed, value of crop, and balance in favor of crop per acre.

Weight of seed and distance planted apart.		Yield		Cost of seed per acre at 75 cents per bushel.	Value of crop per acre at 40 cents per bushel	Balance in favor of crop.
		Bushels.	Tubers.			
Ounces	*Feet*					
12-14	3	146	90,980	$48 00	$58.40	$10 40
10 12	2	220	135,075	60 75	88.00	17 25
8-10	2	195	118,102	49.50	78 00	28.50
6- 8	2	168	115,273	39 00	67.20	28.20
4- 6	2	158	108,908	27.75	63.20	35.45
3- 4	2	146	104,665	19 50	58.40	38 90
2- 3	2	141	81,328	13 50	56 40	42 90
1- 2	2	128	67,184	8 25	51.20	42.95

It appears that in this experiment, with one slight exception, the larger the tuber planted the smaller the profit, and *vice versa*.

2. *Comparison of large and medium sized whole tubers, halves, quarters, and single eyes.*—Potatoes were planted on six plats, each one fourth acre. The results are stated in two tables, which give data for the season of growth and the yield and value of crop for each amount of seed used. The largest yield and next to the largest profit were with whole potatoes. The largest profit was with quarters. "Large whole tubers produced a larger crop and greater value over cost of seed than did the medium sized tubers. Single eyes from large tubers gave a larger and more valuable crop than single eyes from medium sized tubers."

3. *Comparison of whole tubers with halves from wholes of the same weight.*—"This experiment had two objects: (*a*) To note the difference in yield between a certain number of tubers of the same size, planted whole, and twice that number of halves from potatoes of the same size

as the wholes; (*b*) to note if the eyes on the under side of the whole potato materially increase the yield over the half potato planted with the eyes facing outward or upward." Five hundred and forty Early Rose potatoes, weighing 6 to 7 ounces each, were planted in two lots of 270 each. Lot I, the wholes, was planted in three rows and lot II, containing 540 halves, in six rows. The total and average yields are given in a table.

"(*a*) The *half tubers* produced a greater number and greater weight of merchantable potatoes per hill than did the whole tubers; (*b*) the *whole tubers* produced very nearly twice as many unmerchantable tubers *per hill* as did the half tubers; (*c*) the average weight of one hill grown from a whole tuber was 19.5 ounces, while that from half tubers was 16.4 ounces, or an increase per hill of 8.4 per cent by using whole tubers for seed; (*d*) the size of the potatoes grown with half seed is somewhat larger than those from whole seed."

The following summary is taken from the bulletin:

(1) The larger the potato planted, the larger the plant produced, and the more abundant the harvest in tubers.

(2) Other things being equal, the fewer the number of eyes in a piece of seed potato, or the smaller that piece of seed, the smaller the crop.

(3) The larger the quantity of whole tubers placed in a hill for seed, the greater the cost per acre of planting, and the smaller the profit on the crop.

(4) Large and whole tubers produced smaller and poorer merchantable ones, than did half or quarter tubers, or single eyes.

(5) Large and whole tubers yielded appreciably more small unmerchantable potatoes, than did parts of medium tubers or single eyes.

(6) Given, two potatoes of equal size, one planted whole will not yield so large nor so good a crop as will the other tuber cut into halves and each part planted in a separate hill.

(7) The investigation, as carried out, suggests that, in view of the fact that the whole tuber produced comparatively more small, inferior potatoes than did the halves planted, the source of these inferior tubers may be from those eyes located on the under side of the whole potato planted. This because the eyes and shoots thus located are repressed in growth to a certain extent, owing to the pressure upon them and reversal of position.

It is to be remembered that the above conclusions are the result of the investigations recorded and are based on nothing else. Neither in farm practice nor experimental work do we consider that they will *always* find indorsement. Yet as the result of much experimental work with seed potatoes, it is confidently believed that these conclusions will generally be fairly accurate.

Trial of the Rural New Yorker trench system of potato culture.—This is a brief account of an experiment with this system with Early Rose potatoes on an acre of clay loam soil to which a ton of commercial fertilizers was applied. The yield was 188½ bushels of potatoes, which were grown at a loss of $25.50. The author is, however, inclined to attribute the smallness of the crop to the fact that the fertilizer used did not prove available to the plants.

Tests of varieties.—Seventy-four varieties of potatoes were tested and the yields from whole tubers, halves, quarters, and single eyes recorded.

There are also brief descriptive notes on each variety, a record of their keeping qualities taken February 14, and notes on the development of the plants during the season of growth. "While in each class of plantings the yield is variable, often to a considerable extent, an average of all the hills in each class of seed planted of seventy-four varieties, shows a continual decrease in yield and number of tubers per hill, from the whole potato down to the single eye. In brief, *the experiments at this station on the relation of size of seed tubers to crop yield, demonstrate that the larger the piece of seed potato planted, the greater will be the yield.* This, it may be said, is also the result very generally arrived at at other stations that have done similar work."

Early vs. late culture for sweet-potatoes.—Six plats of light clay loam, each one twentieth of an acre in size, were planted to sweet-potatoes at weekly intervals from April 27 to June 1. The variety used was Southern Queen. The yields from each planting are given in a table.

"(1) The largest yield was produced from the planting of May 4.

"(2) Many more unmerchantable potatoes were produced from the first three than from the last three plantings.

"(3) The average yield for the first three plats, or *early planted*, is 489 pounds; of the *late planted*, or last three plats, 510 pounds, or a difference of 21 pounds in favor of later planting.

"(4) The average yield of the plantings from April 27 to May 11 was smaller than of those planted from May 18 to June 1, and each plat contained, on an average, 37 pounds more of unmerchantable tubers than did the several late plantings."

Vermont Station, Bulletin No. 18, January, 1890 (pp. 20).

PIG FEEDING, W. W. COOKE, M. A.—The raising of pigs for the profitable utilization of skim-milk is an important auxiliary of dairying, which is the leading branch of farming in Vermont. Investigation having indicated that the methods of feeding employed by even the best farmers involved a great waste of food materials, the station undertook the experiments reported in this bulletin, with special reference to economy in feeding. Differences in breeds of pigs were also taken into account. The experiment was conducted with two pigs each of the three breeds, Berkshire, Chester White, and Yorkshire, between May 14 and November 11, 1889. The pigs were about five weeks old at the beginning of the trial. The time of the experiment was divided into four periods. The feeding stuffs used were skim-milk, corn meal, and wheat bran, which were fed in rations varied for each period and changing from a very narrow to a wider nutritive ratio. The daily ration for each period was as follows:

I. Skim-milk 2¼ to 6 quarts, with a nutritive ratio of 1:2.

II. Skim-milk 6 quarts, corn meal 4 to 16 ounces, and wheat bran 4 to 22 ounces, with a nutritive value of about 1:2.9.

III. Skim-milk 6 quarts, corn meal 4 to 26 ounces, and wheat bran 20 to 26 ounces, with a nutritive ratio of about 1:3.7.

IV. Skim-milk 6 quarts, corn meal 40 to 54 ounces, and wheat bran 20 to 28 ounces, with a nutritive ratio of about 1:4.3.

Details are given in tables, which include data for the daily rations, gain in live weight by periods and per day, feed consumed, pounds of dry matter required to produce one pound of gain in live weight, a financial summary, net gain per pound by periods, value of the skim-milk, and estimated amounts and values of the fertilizing ingredients in the manure from the feed consumed. The relations of weight and feed, and of weight and profit, are illustrated by diagrams.

The following table herewith gives a summary of the more important data recorded for this experiment:

Summary of results of the experiments in pig feeding

Period.	No. of days in feeding period.	Average weight at end of period.*	Average gain in live weight per day.	Average amount of dry matter in food consumed for each pound increase in live weight.	Average cost of feed consumed for each pound increase in live weight.	Average selling price per pound, live weight.	Average gain (or loss) per pound, live weight.	Total gain (or loss) per pound, during period.	Amount realized from skim-milk, per 100 pounds per period.‡
		Pounds.	*Pounds*	*Pounds.*	*Cents.*	*Cents.*	*Cents.*	*Dollars.*	*Cents.*
I	56	62	0.75	1.34	2.01	4.32	†2.31	†5.77	32
II	34	96	1.07	2.50	3.07	4.32	†1.25	†2.55	25
III	42	155	1.33	3.09	3.54	4.32	†0.78	†2.76	23
IV	49	208	1.42	3.91	4.38	4.32	†0.06	†0.19	14

* Average weight at beginning of experiment, 20 pounds.
† Loss
‡ Allowing for estimated value of manures.

The following are among the results of the experiment as recorded in the bulletin:

The Chester Whites gained in live weight about one fifth faster and required one seventh less food to produce a pound increase in live weight than the others. The Chester Whites produced their growth at a cost, in food consumed, of 3 cents per pound, while the other breeds ate 3½ cents' worth of feed for each pound of growth.

The six pigs together gained 1,088.5 pounds in live weight, or an average per pig of 1.07 pounds per day. They consumed 5,582 quarts skim-milk, 1,223.8 pounds corn meal, and 884.4 pounds wheat bran, or an average of 2.79 pounds dry matter to each pound of gain in live weight. The corn meal used was bought at $18 per ton, and the bran for $16 per ton. The skim-milk was considered worth 15 cents per 100 pounds, or 1¼ cents per gallon. The pigs sold for 5¼ cents per pound, dressed weight, (a lower price than the average), and shrank 18 per cent in dressing, making the selling price equal to 4.32 cents per pound, live weight. The whole selling price was $47.07, and the value of the feed consumed $36.22, leaving a profit of $10.85.

Estimating that four fifths of the nitrogen, phosphoric acid, and potash of the food are saved in the manure, and that they are worth, respectively, 17 cents, 6 cents, and 4½ cents per pound, "which is 25 per cent lower than they cost in commercial fertilizers in Vermont," the total fertilizing value of the manure from the food, which was estimated to cost $36.22, would be $22.66. The gross cost of the food consumed per pound of increase in live weight was 3.33 cents, and the value of the fertilizing ingredients in the food was 2.08 cents, making the net cost of the pork per pound, live weight, 1.25 cents. The value of the food consumed for each pound of increase in dressed weight was 4.06 cents, and the fertilizing value of this food 2.54 cents, leaving the net cost of a pound of dressed pork 1.52 cents. Since the pork sold for 5.25 cents a pound, there was, on this basis, a net gain of 3.72 cents per pound.

While the pigs, on the whole, were fed at a profit, most of it was made in the early periods.

At an average live weight of 155 pounds the pigs were still yielding a profit above the cost of their feed. This profit had ceased when they weighed 208 pounds. It can be said, then, that the experiment shows conclusively that in the case of these pigs, under the best of care, there was no profit in keeping them after they weighed 200 pounds apiece, and it would have been more profitable to sell them at about 175 to 180 pounds weight, and feed what they consumed during the last weeks of their life to younger pigs. * * * If we suppose the manure to offset the care, and subtract from the amount received for the pork the amount paid for the grain fed, the remainder may be considered the amount realized for the skim-milk." The amount realized from 100 pounds of skim-milk for the several pens will be, period I, 32 cents; II, 25 cents; III, 23 cents; IV, 14 cents; average of the whole four periods, 24 cents.

Among the conclusions are the following:

(1) Pig feeding is profitable even at the low price of 5¼ cents per pound dressed weight, provided the pig is sold at an early age, *i. e.* by the time it reaches a live weight of 180 pounds, or soon after.

(2) Grain can be fed to young pigs with profit; in feeding it to pigs weighing over 200 pounds there is a loss.

(3) Young pigs should be fed a ration in which the flesh-producing material is more prominent than the heat or fat-producing.

(4) The old saying, "Grow the pig and then fat him," should be changed to "Grow the pig and then sell him."

(5) This system of feeding and selling makes it possible to raise two sets of pigs in twelve months.

(6) The fertilizing value of the manure from the food consumed by the pig is, in Vermont, equal to nearly one half the value of the pork, and constitutes the largest gain from the feeding.

(7) In these trials the three breeds, Berkshire, Chester White, and Yorkshire, showed but little difference, whatever difference there was being in favor of the Chester White.

[In brief, the two points especially brought out in this experiment are, the value of skim-milk as food for pigs, and the fact that the largest profit is from young animals. These results coincide essentially with

those of many others made elsewhere. There is another important matter in this connection which is generally overlooked. In making pork, dairy farmers have the great advantage that skim-milk is a largely nitrogenous food. A large part of the pork produced in the United States is grown on corn, and in consequence is excessively fat. With nitrogenous food swine have better developed organs and their flesh is leaner. Lean pork is more valuable for nourishment and commands better prices. For further suggestions in this line, see Report of the Office of Experiment Stations in the First Report of the Secretary of Agriculture, 1889, pp. 515–519.]

Virginia Station, Bulletin No. 4, January, 1890 (pp. 18).

A STUDY OF TOMATOES, W. B. ALWOOD AND W. BOWMAN, PH. D.—It is estimated that the value of the tomato crop grown for the canneries and the general market of Virginia is not less than $1,000,000 annually. In view of its high rank, therefore, among the special crops of the State, the station in 1889 began investigations with reference to the plant and fruit, the points for study being as follows:

1. *Cultural and botanical*—(1) Best methods of culture, (2) productiveness of varieties, (3) quality of fruit for canning and for market, (4) earliness, (5) tendency to variation, (6) value of selection, (7) predisposition to become diseased and remedies therefor, (8) selection and improvement of varieties and strains.

2. *Chemical*—(1) Chemical composition of the fruit, (2) chemical composition of the entire plant, (3) effect of different fertilizers.

The investigation was undertaken by the departments of botany and chemistry conjointly. Only a small portion of this work could be carried out during the past season, but it was hoped that by interesting the growers and canners and securing their co-operation, further investigation would be suggested and accomplished.

Field tests with tomatoes.—The report upon this division of the work is stated to be preliminary. The soil of the experimental field, which had been used as a pasture and was much impoverished, is a stiff, upland clay. The plants were set at distances of 4 feet, in rows 6 feet apart, each hill receiving about 1.8 ounces (200 pounds per acre) of a special fertilizer prepared at the station and containing 3.3 per cent of nitrogen, 8 per cent of potash, and 3 per cent of soluble phosphoric acid. While no test of fertilizers was intended, the results seem to indicate that "abundant crops can be grown on poor soil by the direct application of a small quantity of fertilizer in the hill." Leaving out of account the small-fruited varieties, the average yield obtained was nearly 400 bushels per acre. It is advised that to insure vigor and productiveness of plants they should be transplanted once at least before their final transplanting to the field.

The varieties used were thirty-nine, and included those considered

standard, and also some of recent introduction. The special value of a variety of tomato for the canning industry and for market purposes is believed to lie in its being a strong, vigorous grower, productive, yielding smooth, good sized fruit, reasonably early, fruiting without deterioration through a good length of season, and, if possible, free from fungous diseases, though season, situation, and culture probably govern these characteristics in the large-fruited varieties. Solidity, involving firmness and capacity to endure shipment and other handling, is also a matter of prime importance, but one on which judgment is not easily rendered. The pear-shaped and plum-shaped varieties are vigorous growers, very productive, and resisted the rot almost perfectly. Of the larger tomatoes, Paragon, Trophy, Beauty, and Acme were vigorous in the vine and also rank among the most productive varieties. Acme fully sustained its reputation as one of the best for general purposes. Extra Early is very prolific, but its fruit is inferior. Mikado is one of the best of the potato-leaved varieties, but proved irregular, and selection has been undertaken to establish a better type. The first ripe fruits were observed on the currant and cherry varieties on July 13, and ten days later on Conqueror and Excelsior (Hathaway's).

For the critical notes of the experiment six typical plants of each variety were selected, and a table shows for these the total number and weight of sound and of diseased fruit, date of first ripe fruit, days from seed till first ripe fruit, period of greatest productiveness, and average number and weight of fruits from each plant.

Chemical composition of tomatoes.—Determinations of the water content of samples from nine varieties were made, and specimens of one variety (Trophy) were analyzed. The method of drying specimens for analysis is described, and tables are given showing the results of the analyses. In the water content of different varieties a variation of 1.18 per cent is noted, the average being 93.63 per cent. When compared with former analyses of the tomato, as will be observed in the following table, these results differ considerably in the respective percentages of nearly every ingredient; and, if confirmed by future work, will tend to show unusually wide limits of variation in the composition of tomatoes from causes to be sought in climate, soil, and culture.

	Calculated to original sample.						Calculated to dry matter.				
	Water.	Fat.	Fiber.	Protein.	Ash.	Carbohydrates.	Fat.	Fiber.	Protein.	Ash.	Carbohydrates.
Dahlen	92.87	0.33	0.84	1.25	0.64	4.07	4.63	11.78	17.53	8.97	57.09
New York Station	91.26	0.47	0.70	1.00	0.73	5.84	5.38	8.01	11.44	8.35	66.82
New Jersey Station	94.00	0.41	0.54	0.78	0.49	3.78	6.83	9.00	13.00	8.17	63.00
Virginia Station	93.34	0.47	1.16	1.04	0.34	3.65	7.05	17.40	15.68	5.07	54.80

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRI-

BUREAU OF ANIMAL INDUSTRY.

ANIMAL PARASITES OF SHEEP, C. CURTICE, D. V. S., M. D. (pp. 222, illustrated).—This is a copiously illustrated manual of information on the parasites and parasitic diseases of sheep. It includes articles on the grub in the head (*Œstrus ovis*, Linn.); sheep-tick (*Melophagus ovinus*, Linn.); sheep louse (*Trichodectes sphærocephalus*, Nitzsch); goat louse (*Trichodectes limbatus*, Gervais, and *T. climax*, Nitzsch); head scab (*Sarcoptes scabiei*, de Geer, var. *ovis*); common scab (*Psoroptes communis*, Fürst, var. *ovis*); foot scab (*Chorioptes communis*, Verheyen, var. *ovis*); pentastoma (*Linguatula tænioides*, Rud.); bladder worm (*Tænia marginata*, Batsch); gid or staggers (*Tænia cænurus*, Küch.); hydadids (*Tænia echinococcus*, v. Sieb.); mutton measle (*Tænia tenella*, Cobbold); fringed tape-worm (*Tænia fimbriata*, Diesing); broad tape-worm (*Tænia expansa*, Rud.); large liver fluke (*Distoma hepaticum*, Linn.); small liver fluke (*Distoma lanceolatum*, Metilis); *Amphistoma conicum*, Zeder; *Strongylus contortus*, Rud.; intestinal round worms (*Strongylus filicollis*, Rud.; *S. ventricosus*, Rud.; *Ascaris lumbricoides*, Linn.; *Dochmius cernuus*, Creplin; *Sclerostoma hypostomum*, Dujardin; *Œsophagostoma columbianum*, Curtice; *Trichocephalus affinis*, Rud.); hair lung-worm (*Strongylus ovis-pulmonalis*, Diesing); and thread lung-worm (*Strongylus filaria*, Rud.).

In the introduction Dr. Salmon states that great care has been bestowed on the illustrations, nearly all of which are original and were drawn from nature.

> The nodular disease of the intestines (*Œsophagostoma columbianum*, Curtice), together with its cause, is described for the first time in these pages. This disease is common and wide-spread, but its cause and nature were mysterious until they were discovered through the investigations of this Bureau. * * * The facts obtained in the investigations of the fringed tape-worm and the hair lung-worm are also of more than ordinary interest.

DIVISION OF BOTANY.

CONTRIBUTIONS FROM THE UNITED STATES NATIONAL HERBARIUM, No. 1 (pp. 1-28) AND No. 2 (pp. 29-65).—These are the first numbers of a series of publications intended to bring to the notice of botanists the

collections of the National Herbarium, which has already attained large proportions, and is being rapidly augmented. The intention is to furnish information regarding the flora of the different sections of the United States under investigation by agents of this Department or by volunteer observers and collectors in the newer districts. No. 1 contains papers by G. Vasey and J. N. Rose, which include lists of plants collected by Dr. Edward Palmer in Southern California in 1888 and in Lower California in 1889, with notes and descriptions of new species. No. 2 contains an article by J. M. Coulter on a collection of plants made by Mr. G. C. Nealley in 1887, 1888, and 1889, in the region of the Rio Grande, in Texas, from Brazos Santiago to El Paso County. A list of 903 species is given, with brief descriptive notes on some of the species. The collection is especially rich in species of the native grasses of that region.

DIVISION OF ENTOMOLOGY,

BULLETIN NO. 22 (pp. 110).

REPORTS OF OBSERVATIONS AND EXPERIMENTS IN THE PRACTICAL WORK OF THE DIVISION.—This bulletin comprises such reports of the field agents of the Division for 1889 as in previous years would have been published in the annual report of this Department.

Various methods for destroying the red scale of California, D. W. Coquillett (pp. 9–17).—An account of experiments with resin soaps and compounds, and the "Eureka Insecticide" for the destruction of the red scale (*Aspidiotus aurantii*, Maskell). A portion of the report of Mr. Coquillett, which relates to the discovery of a method whereby trees infested with the red scale can be treated with hydrocyanic acid gas at an expense scarcely exceeding one third of that required by the old method, is not included in this bulletin, having been previously published in Insect Life, Vol. II, double No. 6 and 7.

Insects of the season in Iowa, H. Osborn (pp. 18–41).—A report on insects injurious to grasses, including notes on the following leaf-hoppers: *Diedrocephala mollipes*, *D. noveboracensis*, *D. versuta*, *D. coccinea*, *Tettigonia hieroglyphica*, *Agallia quadripunctata*, *A. sanguinolenta*, *Allygus irroratus*, *Cicadula exitiosa*, *Jassus inimicus*; on the grass-root plant-louse *alias* the dogwood plant-louse (*Schizoneura corni*, Fab.); and on the chinch-bug (*Blissus leucopterus*, Say.) and the long bug (*Ischnodemus falicus*, Say.).

Insects affecting grains, F. M. Webster (pp. 42–72.)—Notes on the wheat-straw worm (*Isosoma tritici*, Riley), wheat-stem maggot (*Meromyza americana*, Fitch), western striped cut-worm (*Agrotis herilis*, Grote), army-worm (*Leucania unipuncta*, Haw.), fall army-worm (*Laphygma frugiperda*, Ab. and Sm.), a new cut-worm (*Luperina* [*Hadena*] *stipata*, Morr.), white grub (*Lachnosterna* sp.?), varying anomala (*Anomala varians*, Fab.), wheat wire-worm (*Agriotes mancus*, Say.), *Drasterius ele-*

gans, Fab., *Diabrotica 12-punctata*, swamp sphenophorus (*Sphenophorus ochreus*, Lec.), chinch-bug (*Blissus leucopterus*, Say), grain aphis (*Siphonophora avenæ*, Fab.)

Notes from Missouri for 1889, *M. E. Murtfeldt* (73–84).—Brief notes on *Ceuthorrhynchus rapæ*, *Phyllotreta vittata*, *Anisopteryx vernata*, *Aphididæ*, *Gortyna nitela*, *Corimelæna pulicaria*, *Lygus lineatus*, *L. pratensis*, *Plagiodera scripta*, *Diabrotica* 12-*punctata*, and *Pieris rapæ*; and more detailed notes on special studies on the spinach beetle (*Disonycha collaris*, Fab.), new rose slug (*Cladius isomera*, Harris), white fringe-slug (*Selandria* sp. ?), *Palthis angulalis*, and *Phylloxera rileyi*.

California insects, *A. Koebele* (pp. 85–94).—Notes on the madrona tree borer (*Polycaon confertus*, Lec.) *Chrysobothris mali*, Horn., *Diabrotica soror*, Lec., tent caterpillars (*Clisiocampa* spp.), cut-worms, codling moth (*Carpocapsa pomonella*) and its enemies and parasites, Hessian fly (*Cecidomyia destructor*), joint worms (*Isosoma* spp.), and locusts.

Nebraska insects, *L. Bruner* (pp. 95–106).—Notes on the false chinch-bug (*Nysius angustatus*), cut-worms, army-worm (*Leucania unipuncta*), green-lined maple worm (*Anisota rubicunda*), blue-grass weevil (*Sphenophorus parvulus*), corn-root worm (*Diabrotica longicornis*), 13 species of insects injurious to trees on tree claims, and locusts.

CENTRAL EXPERIMENTAL FARM OF CANADA.

Bulletin No. 6, January, 1890 (pp. 25).

BARLEY, WILLIAM SAUNDERS.—The demand for Canadian barley has largely fallen off of late in the United States, from the fact that corn, rice, glucose, and other materials are being substituted for barley in the manufacture of beer. It is therefore urged that Canadian farmers should seek a market for their surplus barley in Great Britain. Hitherto six-rowed barley has been chiefly grown in Canada. British brewers prefer two-rowed barley. A practical test by a Canadian maltster is reported which showed the superiority of the two-rowed barley for malting purposes. This is partially explained by the fact that the weight of the husk in proportion to the kernel is less in the two rowed than in the six-rowed varieties.

To find whether two-rowed barley can be successfully grown in Canada, tests on a comparatively large scale have been undertaken by the several experimental farms, and these have been supplemented by experimental trials by a large number of farmers in different parts of the Dominion.

The cultivation of barley on the Central Experimental Farm has been carried on with many sorts and in several different methods. Experiments with field crops have been conducted to ascertain the relative yield and quality of the several varieties under such conditions, and also with the individual sorts grown under exactly the same circumstances.

A very uniform piece of light sandy loam land of the Central Farm was selected on which fifty kernels of each of numerous varieties of barley were planted. A mixture of nitrate of soda, bone-dust, and unleached wood ashes was used as a fertilizer. When the crop of 1888 was harvested, one of the best examples of each sort was thrashed and cleaned separately, the number of heads counted, and the yield ascertained; a second selection of three or four more of the most vigorous plants was similarly treated, and those remaining were harvested together and their average yield obtained. During 1889 the same varieties were planted together with additional sorts. The results are given in a table which contains data for thirty-five varieties. The length of the growing season of the two-rowed barleys varied considerably for

the two years in which the tests were made, but it is thought would probably average from ninety-five to one hundred days in the vicinity of Ontario. "All the varieties of two-rowed barley are later in ripening than the six-rowed sorts, the difference varying from five or six to ten or twelve days." The yields of 1889 were considerably larger than those of 1888, due in part to a more careful selection of seed and to acclimatization.

The results obtained with several varieties of two-rowed barley planted ten to sixteen days later than the rest are given as indicating the advantage of early sowing. A table shows the comparative yield of fifteen two-rowed varieties at four of the experimental farms in 1889, and there are also notes on the results obtained by farmers in different parts of the Dominion for five varieties—Carter's Prize Prolific, Danish Chevalier, Danish Printice Chevalier, English Malting, and Beardless.

The results "are sufficient to show that even in an unfavorable season for barley growing there is a wide territory over which two-rowed barley for the English market can be grown with advantage, and the yield obtained from the samples sent out, as well as in field culture at the experimental farms, would indicate that heavier crops of two-rowed barley, of the varieties named, could be raised than of the ordinary six-rowed barley. It is not practicable to entirely change any important crop in a single season, especially when it covers so large an area; it is better for many reasons that such a change should come more slowly, but it does seem feasible to bring this about to a very large extent within a comparatively short time. A very large quantity of barley is required every year for feed, and the fact that the two-rowed sorts are on an average from a week to ten days later in ripening than the six-rowed might be an objection to their growth in some places."

It is not to be expected that malting barley of the right quality can be grown in every part of Canada. Whether the best conditions exist for this crop in any locality can be ascertained only by repeated tests. In proof of what may be done to "improve the barley crop of a country, the case of Denmark, now a large exporter of malting barley," is cited.

Directions for the cultivation, harvesting, and storing of two-rowed barley are given in considerable detail.

Experiments are also reported with thirteen varieties of six-rowed barley, with seven other varieties grown for feed, and with seven varieties from seed grown at high altitudes in India.

EXPERIMENT STATION NOTES.

The following circulars have been issued by the executive committee of the Association of American Agricultural Colleges and Experiment Stations:

OFFICE OF THE EXECUTIVE COMMITTEE,
Agricultural College, Md., July 24, 1890.

The contents of this circular concerns both colleges and stations.

The annual Agricultural Appropriation Bill for the current fiscal year of the United States, approved July 14, 1890, and printed as "Public — No. 213," includes the appropriation for agricultural experiment stations, and directs that the same "shall be paid quarterly, in advance." The accounts have to-day been certified, and the Treasury Department officials state that the drafts for the first quarter will be mailed at Washington within ten days.

The following order has been signed by the Postmaster-General and will be promulgated in the August issue of the Official Postal Guide:

Order No. ——. Paragraph 3, section 419, Postal Laws and Regulations, 1887, is hereby amended so as to read as follows:

"Only such bulletins or reports as shall have been issued after the station became entitled to the benefits of the act can be transmitted free, and such bulletins or reports may be inclosed in envelopes or wrappers, sealed or unsealed. On the exterior of every envelope, wrapper, or package must be written or printed the name of the station and place of its location, the designation of the inclosed bulletin or report, and the word 'Free' over the signature or fac simile thereof of the officer in charge of the station, to be affixed by himself, or by some one duly deputed by him for that purpose. There may also be written or printed upon the envelope or wrapper a request that the postmaster at the office of delivery will notify the mailing station of the change of address of the addressee, or other reason for inability to deliver the same, and upon a bulk package a request to the postmaster to open and distribute the 'franked' matter therein, in accordance with the address thereon.

"Bulletins published by the U. S. Department of Agriculture and analogous to those of the station, and entitled to be mailed free under the penalty envelope of that Department, may also be adopted and mailed by the several stations, with their own publications, under the same regulations, and any bulletins or reports mailable free by any agricultural experiment station under these regulations may be so mailed by any other station having free mailing authority.

"If such station's annual reports be printed by State authority, and consist in part of matter relating to the land grant college to which such station is attached, then said report may be mailed free entire by the director of the station; provided, in his judgment, the whole consists of useful information of an agricultural character."

The undersigned ventures the opinion that the advantages to be derived by the institutions concerned, from the new legislation and regulations quoted above, which were procured by and for this Association through the medium of its executive committee, will more than repay every college and station, in dollars and cents, for its contributions to the Association the present year.

Very respectfully yours,

HENRY E. ALVORD, *Chairman,*
For the Executive Committee.

OFFICE OF THE SECRETARY,
State College, Pa., August 9, 1890.

DEAR SIR: By authority of the executive committee, a delegate convention of this Association is hereby called to meet at Champaign, Ill., at noon of Tuesday, November 11, 1890.

Attention is called to the following article of the constitution of the Association respecting membership:

"At any regularly called meeting of the Association each college established under the act of Congress approved July 2, 1862, and each experiment station established under State or Congressional authority, and the Department of Agriculture, shall be entitled to one delegate, but no delegate shall cast more than one vote. Other institutions engaged in experimental work in the interest of agriculture may be admitted to representation in this Association by a majority vote at any regular meeting of the Association.

In accordance with the requirements of the amendment to the constitution adopted at the last convention of the Association, the permanent committee on chemistry and on horticulture and the standing committee on college work are hereby designated to present a portion of the subjects coming before them in the general sessions of the convention.

The executive committee is not yet able to announce the program of the meeting, but will do so at an early day.

Very respectfully,

HENRY E. ALVORD, *Chairman,*
For the Executive Committee.
H. P. ARMSBY,
Secretary.

ALABAMA COLLEGE STATION.—W. B. Frazer has been appointed clerk and accountant to the director. Two additional silos are being built. Provision has been made for the establishment of a poultry department in charge of the agriculturist.

COLORADO STATION.—The duties of agriculturist of the station have, under the present arrangement, devolved upon the director, C. L. Ingersoll, M. S., who is aided by R. H. McDowell, B. S., as assistant agriculturist. The last work of the late Prof. James Cassidy, as botanist and horticulturist of the station, has been embodied in a bulletin entitled "Some Colorado Grasses and their Chemical Analysis," published in July.

CONNECTICUT STATE STATION.—In order to bring the results of fertilizer inspection promptly to the attention of the public, weekly statements of analyses are sent to the two agricultural papers most widely circulated in Connecticut and to the secretaries of all granges, farmers' clubs, and agricultural societies in the State.

GEORGIA STATION.—The contract with the State University, under which the scientific laboratory work of the station during the past year has been done at the University, expired by limitation of terms June 30. The station staff now comprises the director, chemist, horticulturist, and agriculturist, of whom all except the chemist reside upon the station farm. The board of directors will shortly commence to erect on the farm suitable buildings for laboratory, barns, and dairy. The building fund allowed by the United States act of March 2, 1887, from the appropriation to the station for the first year, having been expended at Athens, the board is now greatly embarrassed for means to erect proper buildings.

ILLINOIS STATION.—George P. Clinton, B. S., has been added to the station staff as assistant botanist.

LOUISIANA STATION.—The legislature has increased the annual appropriation for the stations from $6,000 to $9,000, and has passed a law to prevent, by station supervision, the adulteration of Paris green. Facilities for experiments in sugar making have been provided on a limited scale at the North Louisiana Station. At the semi-annual meeting of the State Agricultural Society, held in Agricultural Hall at the

North Louisiana Station, June 23 and 24, 1890, over one thousand farmers were in attendance.

The station's experiments with sorghum comprise over one hundred varieties, including many grown from pedigreed seed. The sugar experiments for this season began August 1.

W. Wipprecht, B. S. A., formerly of the Texas Station, has been appointed chemist at the Sugar Experiment Station, Audubon Park, New Orleans.

MASSACHUSETTS STATE STATION.—Charles H. Jones, B. S., and Henry D. Haskins, B. S., have been appointed assistants, vice E. R. Flint, B. S., and E. E. Knapp, B. S.

MINNESOTA STATION.—Experiments are being carried on in the northwestern, southwestern, and southeastern parts of the State, at points widely remote from each other, in which an attempt is being made to determine what fertilizers can best be used to renew land exhausted by successive cropping with wheat, "after all the wheat is gone out of the land." The station botanist is investigating a new and fatal disease which has attacked growing flax in the southern part of the State, with a view to determining the nature and origin of the disease, and to discovering a cheap and effective fungicide, together with a practical method for its application. It is estimated that the station publications now reach 25,000 English-reading farmers in Minnesota alone.

MISSOURI STATION.—B. Von Herff resigned his position as assistant chemist of this station July 1, 1890. During the current year this station has expended $5,000 in the erection of feeding stables and sheep and hog sheds, to take the place of a station barn destroyed by fire in May, 1889.

NEW YORK STATE STATION.—Dr. L. L. Van Slyke has been appointed chemist, vice E. F. Ladd, whose present address is 14 East Thirty-fourth street, New York City.

NEW YORK CORNELL STATION.—A forcing-house for the division of horticulture has lately been completed. It is supplied with facilities for experiments on the effect of electric light on plants, and investigations in this line have been begun.

NORTH CAROLINA STATION.—F. E. Emery, of the New York State Station, has been elected agriculturist to this station and will enter on his new duties in September. J. R. Chamberlain, B. S., who has been acting agriculturist since his election to the chair of agriculture, live stock, and dairying in the North Carolina College of Agri-Culture and Mechanic Arts, will hereafter devote his whole attention to the work of instruction. As an outcome of the co-operative field experiments with fertilizers carried on by the station several years in different parts of the State, it has been decided to confine such experiments to a comparatively small number of central localities, possibly one in each Congressional district, with a view to the gradual establishment of distinct stations. This station has recently begun to issue "Press Bulletins," giving, in very brief and popular form, results of experiments at the stations and such statements regarding subjects more or less intimately allied to the work of the station as are thought likely to be of general interest. The station has already secured the co-operation of a large number of papers in the State for the publication of material contained in these bulletins. Among the subjects treated in recent Press Bulletins are the following: Does it pay to fatten sheep with cotton-seed hulls and meal? Fertilizers for corn; grapes at the station; the weather service; cow-peas for wheat.

NORTH DAKOTA STATION.—C. B. Waldron has been appointed botanist of this station, and will also, for the present, do some work in entomology. The station has begun to collect and classify the grasses, noxious weeds, and injurious insects of the State. Adequate apparatus for work in botany has been provided. The board of control has authorized the appointment of a chemist for this station with special reference to the classification and analysis of the soils of the State. Experiments with methods of cultivation and varieties of wheat are in progress and investigations on rust, which threatens serious injury to the crops of the present season, are being made. The farmers and press of the State are reported to be manifesting great interest in the new station and college.

Vermont Station.—D. W. Colby, B. S., has resigned the position of assistant chemist. A. B. Cordley, B. S., formerly assistant in entomology at the Michigan Agricultural College, has been appointed microscopist of this station. A complete meteorological service has been inaugurated at the station. A large barn has been erected. The station herd now includes Jersey, Ayrshire, Holstein, Devon, and Guernsey cattle.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

JULY 1 TO AUGUST 1, 1890.

Division of Statistics:

Report No. 75 (new series), July, 1890.—The Area of Corn, Potatoes, and Tobacco.

Division of Botany:

Contributions from the United States National Herbarium, No. 2.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXEPIMENT STATIONS.

JULY 1 TO AUGUST 1, 1890.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Bulletin No. 16 (new series), June, 1890.—Corn, Cotton, Rye, Chufas.

Bulletin No. 17 (new series), July, 1890.—Dry Application of Paris Green and London Purple for the Cotton Worm.

ARKANSAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 12, April, 1890.—Influence of Spaying on Milk Production; Milk Analysis; Cotton Worm.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF CALIFORNIA:

Annual Report for 1888 and 1889, Part IV.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ILLINOIS:

Bulletin No. 9, May, 1890.—Milk and Butter Tests; Comparative Value of Corn Fodder and Silage in Feeding Yearling Heifers.

KANSAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 10, May, 1890.—Notes on Conifers.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 37, July, 1890.—Feeding Experiments with Lambs; Analyses of Feeding Stuffs and Fertilizers.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meteorological Bulletin No. 18, June, 1890.

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 12, June 25, 1890.—Cotton Leaf Worm.

NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS:

Bulletin No. 65, January 31, 1890.—Experiments with Different Breeds of Dairy Cows.

Bulletin No. 66, March 1, 1890.—Fertilizing Materials.

Bulletin No. 67, May 3, 1890.—Notes on the Wheat Louse.

Bulletin No. 68, April 30, 1890.—Experiments with Different Breeds of Dairy Cows.

Annual Report for 1889.

NEW YORK AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 19 (new series), June, 1890.—A Method for the Determination of Fat in Milk and Cream.

Bulletin No. 20 (new series), June, 1890.—Pedigrees of Dairy Animals under Investigation.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 67*a* (Technical Bulletin No. 1), October 15, 1889.—Seed Tests.

Bulletins Nos. 68*a*, 68*c*, 69*a*, 69*b*, 70*a*, 72*a*, November 15, 1889—July, 1890.—Meteorological Data.

EXPERIMENT STATION RECORD.

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EDITORIAL NOTES.

The seventh annual convention of the Association of Official Agricultural Chemists was held in the lecture room of the National Museum at Washington, August 28, 29, and 30. The attendance was larger than that of any previous meeting. About forty chemists were present. Twenty experiment stations were represented. The meeting was marked by earnestness of purpose, strict attention to the work in hand, manifest disposition on the part of the members to study more closely and thoroughly the questions involved before taking decisive steps, and an increased tendency towards conservatism in regard to alterations in methods.

The results returned by those who had co-operated in the analyses of materials sent out by the reporters on different subjects, while they differed widely in many cases, were, on the whole, an improvement over last year's. In the nitrogen determinations especially, the agreement of results by different analysts was much better. The changes adopted in the methods of last year, which will be better understood by reference to the proceedings of the last convention,* are in substance as follows:

Nitrogen: Kjeldahl method.—The determination of the absolute strength of the standard hydrochloric acid solution by means of sodium carbonate was discarded; in standardizing with either potassium tetroxalate, or ammonia distilled from ammonium chloride and sodium hydroxide, cochineal or dimethyl aniline orange is to be used as an indicator. For the digestion, in place of 0.7 gram of mercuric oxide, its equivalent of metallic mercury may be used. To prevent bumping of the solution in distilling, the addition of 0.5 gram of zinc dust is recommended, instead of granulated zinc. In the determination of nitrogen in nitrates, zinc sulphide may be employed in place of zinc dust. If zinc sulphide is substituted for zinc dust one gram of salicylic acid may

*Bulletin No. 24 of the Division of Chemistry of the U. S. Department of Agriculture.

be used with two grams of zinc sulphide. The use of one flask for both digestion and distillation, thus doing away with the necessity of transferring the solution from the digestion to the distillation flask, is strongly recommended.

Phosphoric acid.—The methods recommended for preparation of sample and determination of moisture remain the same as last year. In estimating the water-soluble phosphoric acid the residue is to be washed until the filtrate measures 250 c. c. In filtering off the portion soluble in citrate of ammonia, washing with water at 65° C. is recommended. In making up the solution for total phosphoric acid, with all fertilizers containing cotton-seed meal, the substance is to be first evaporated with magnesium nitrate and ignited. In the preparation of the neutral citrate of ammonia solution, a "saturated alcoholic solution of coralline" should be used as an indicator. The present method of determining reverted or citrate-soluble phosphoric acid was discussed at some length, and the reporter on phosphoric acid for the coming year was requested to make a careful study of the preparation of the citrate of ammonia solution and the time of digestion.

Potash.—The changes adopted were but slight, the methods of last year having proved satisfactory and reliable. Attention was called to the necessity of first charring substances containing organic matter, as cotton seed meal, etc., before making up the solution, this precaution to be observed in both the Lindo Gladding method and the alternate method. In the former method, the direction to "cool the solution" before adding ammonium oxalate and ammonia, is omitted. The wording of the alternate method is changed to avoid ambiguity, but the general import remains unaltered.

Cattle foods: Preparation of the sample.—The substance is to be ground until all of it will pass through a sieve of plate metal with circular holes 1 millimeter in diameter. *Moisture.*—The substance is to be dried during four hours, instead of "to constant weight." *Ash.*—The method remains the same as last year, with the exception that the determination of carbon dioxide in the charred mass is omitted, and the material heated at low redness to a white ash. *Fat.*—The ether extraction is to be carried on during sixteen hours, instead of "until extraction is found by test to be complete." *Protein.*—In estimating crude protein the nitrogen is to be determined by the Kjeldahl method, as directed for nitrogen in fertilizers, and the result multiplied by 6.25. *Crude fiber.*—In the method for crude fiber the use of the air blast in boiling with acid and alkali is made optional; the directions as to filtering are dropped, and the washing with alcohol and ether is omitted.

Dairy products.—*Butter.*—The sample of about 500 grams, which may be taken with a butter tester, is to be perfectly melted in a closed vessel at as low a heat as possible, and shaken violently to mix; a portion of this is poured into the vessel from which it is to be weighed out for analysis, and kept in motion until cool. *Specific gravity.*—This may be

determined as recommended last year, but the method of computing the weight of the contents of a flask at any temperature, according to the formula given on page 17 of Landolt and Börnstein's tables,* is made an alternate. *Water.*—1.5 to 2.5 grams of the butter are to be dried to constant weight at the temperature of boiling water in a flat-bottomed dish presenting a surface of at least 3 square inches. The use of clean, dry sand or asbestos is considered advisable. *Total fat.*—The dried butter from the water determination is dissolved in the dish with absolute ether or with "76° benzine." The contents of the dish are then transferred, with the aid of a wash bottle filled with the solvent, to a weighed Gooch filter, and washed until free from fat. The crucible and contents are heated at the temperature of boiling water to constant weight and the weight of fat calculated. *Alternate method for fat.*—Water may be determined by drying the butter on asbestos or in sand and the fat extracted with anhydrous alcohol-free ether, in an extraction apparatus. The extract, after evaporation of the ether, is heated to constant weight at the temperature of boiling water.

The Kjeldahl method was adopted as an alternate method for the determination of curd, the nitrogen factor 6.25 to be used.

Milk: Water.—In the description of the method for the determination of water, as recommended for last year, the word platinum is to be stricken out, thus allowing the use of dishes of glass or porcelain as well as platinum. The use of sand in drying is made optional. *Nitrogen.*—In determining total nitrogen according to Kjeldahl, the previous evaporation of the milk may be omitted. *Fat.*—The Adams method was again accepted, but the following modifications recommended. Instead of extracting each coil of paper before use, a constant correction, based upon determination of the extract from a large number of like strips, may be supplied. The milk or cream is to be run on to the paper from a pipette, to avoid the danger of selective absorption. The methods of Morse, Piggott, and Burton, and that of Macfarlane, as alternates, are discarded. *Sugar.*—The reduction of alkaline copper solution is made an alternate method. *Ash.*—The method remains unchanged, except that the use of the muffle in burning is made optional.

The reporter for the ensuing year was requested to test and report on the various rapid methods for milk analysis.

An extensive report on sugar was presented by Prof. H. W. Wiley; accompanying this a full index to the literature of carbohydrates since the publication of Professor Tollens' book, with important abstracts, was submitted.

The report of the committee on ways and means for securing more thorough methods for the analysis of foods and feeding stuffs, was presented by Prof. W. O. Atwater. This report urged the pressing necessity of such abstract studies as will bring definite knowledge of the proximate ingredients contained in each substance to be analyzed,

* Physikalisch-Chemische Tabellen von Landolt und Börnstein. Berlin, 1883.

attention being given not only to the behavior of each proximate compound with re agents, but also to its elementary composition, molecular constitution, changes under the action of ferments, digestibility, and potential energy. The importance of collateral studies from the standpoint of vegetable physiology and histology was urged, and the necessity of classifications of the compounds, based upon their actual properties, and of improved methods for separation, quantitative estimation, and estimates of nutritive values, was dwelt upon. It was suggested that chemists in educational and other institutions, as well as in the experiment stations, might co-operate; that pecuniary aid for such researches should be sought; and that the results would be valuable in the highest degree as contributions to science, as well as for their practical usefulness.

The report of Professor Rising on fermented liquors was accepted without discussion, and the recommendations of last year continued.

In addition to the reports above mentioned several papers were read. Among these were: Notes on Occurrence and Quantitative Estimation of Pentaglucoses in Fodders and Feeding Stuffs, by Dr. W. E. Stone, the tenor of which is well indicated by the title; Determination of Phosphoric Acid in Cotton-Seed Meal, by F. B. Dancy, the paper tending to show that the last two official methods of the past year were wholly inadequate in case of this material; Differences in the Determination of Reverted Phosphoric Acid, by Dr. Charles Gibson, of Chicago. Prof. H. A. Huston spoke on variations in the determination of citrate-soluble phosphoric acid caused by different factors, illustrating his remarks by means of charts.

As recommended by the executive committee, the chapter of cattle foods was divided under two heads, materials high in carbohydrates, and those low in these constituents; and a reporter was appointed for ash and soil analysis. A committee, consisting of Messrs. Wiley, Atwater, and Robinson, was appointed to inquire into the desirability and feasibility of establishing a chemical laboratory at the Columbian Exposition to be held at Chicago in 1893, and requested to report at the next meeting of the Association.

A committee, consisting of Messrs. Wiley, Stubbs, Frear, Caldwell, and Nicholson, was appointed to confer with committees from the American and the Washington Chemical Societies, and other chemical bodies, regarding the formation of a National Chemical Society.

The officers and reporters elected for the ensuing year are as follows: President, G. C. Caldwell; vice-president, N. T. Lupton; secretary, H. W. Wiley; executive committee, R. C. Kedzie and E. B. Voorhees; reporters, on nitrogen, William Frear; on phosphoric acid, H. A. Huston; on potash, H. B. Battle; on ash and soil, R. C. Kedzie; on dairy products, W. W. Cooke; on foods and feeding stuffs high in carbohydrates, A. E. Knorr; on foods and feeding stuffs low in carbohydrates, C. D. Woods; on sugar, W. C. Stubbs; on fermented liquors, W. B. Rising,

The importance of the effort to build up the sugar-beet industry in the United States is appreciated by the experiment stations, as is shown in the abstracts of their experiments in this and other numbers of the Experiment Station Record.

Bulletin No. 27 of the Division of Chemistry of the Department of Agriculture, just issued, contains an historical sketch of the beet-sugar industry, a full discussion of the soil, climate, and fertilizers suitable for beet culture, together with brief descriptions of the methods of manufacture and of the machinery to be used therefor. It also treats of the present condition of the beet-sugar industry in the United States, locates approximately those portions of the country which are best suited for the production of the sugar-beet, and indicates the line of work necessary to the successful introduction and extension of the beet-sugar industry in this country.

Prof. H. W. Wiley, by whom the bulletin referred to was prepared, has, at the request of the Director of this Office, made the following suggestions regarding the work of the stations on the sugar-beet: "In my judgment the work of the stations in respect to the beet-sugar industry should, for the present, consist in the careful study of soil and climatic conditions, and an experimental demonstration of the best methods of producing beets for sugar and for seed. There is no necessity for an experimental study of the methods of manufacture, and no opportunity for the production of beets on a large scale. If the stations can teach by actual demonstration the proper methods of beet culture and seed production, it is all that can reasonably be asked of them."

In this connection the following statements, kindly furnished by Dr. A. T. Neale, director of the Delaware College Experiment Station, are of decided interest. The author has spent several years among European experiment stations, particularly in Germany, was for some time assistant in the experiment station at Halle, in Prussia, which is located in the immediate vicinity of the beet-sugar district of the Province of Saxony, and has devoted especial attention to the sugar industry. The description of the methods used by seedsmen for improving varieties of beets, and of the experiments by which different varieties are tested by the Halle Station, with the co-operation of sugar-beet farmers, are from notes of a recent visit there.

Continental seedsmen in general, and Germans in particular, have followed well-known methods for raising the standard of the sugar-beet. The efforts in Germany have been supplemented and in a measure incited by the control and comparative tests executed by the Prussian Experiment Station at Halle, under the direction of Professor Maercker. The first ten years of that control have now passed and a review of its work may be suggestive to officials of American stations.

Laws enacted twenty years ago by the German Parliament levied a a tax of $4.25 upon each and every ton of beets admitted within the

walls of a sugar factory, regardless of the quality. Consequently the higher the percentage of sugar in beets, the lower was the tax upon a pound of sugar. Small beets, small crops, and high sugar tests often go hand in hand; hence such beets have been sought by purchasers, and the tendency has been to find profit more in the management of sugar-houses than in operations of the farm. Seedsmen naturally aimed to supply the existing demand.

Improvement of varieties of the sugar-beet in Germany—Methods of breeding.—The following notes, taken personally at the establishment of Dippe Brothers, Quedlinburg, Prussia, will illustrate the extent of the German beet-seed industry and will describe one of the methods of breeding now in actual use. The establishment includes a farm of 5,700 acres, all of which is in the highest possible state of cultivation, and a chemical laboratory, with room, equipment, and working force sufficient to test the sugar content of many thousands of samples of beets in a comparatively short time. One quarter of the farm is devoted each year to the sugar-beet. The beet in its natural condition is an annual, but years of breeding and cultivation have so changed its nature, that at present less than 3 per cent of pedigreed plants develop seed at the close of the first season; that is, less than 3 per cent tend to revert to the original type. Beets known technically as "mothers" are dug in the fall and stored during the winter; if they are planted during the spring they will produce seed during the following fall.

Two radically different varieties are regarded with favor. One, the Vilmorin, is of French, and the other, the Klein Wanzleben, of German descent. A standard shape, size, and weight have been fixed as indicative of the best development attained by each variety. When the beets are dug in the fall, those which satisfy these standards are stored until the following spring and are then subjected to chemical analysis. Those which come up to a given standard of sugar content are used for growing seed, the rest are rejected. The method* of obtaining samples of individual beets for analysis is briefly as follows: By means of a special instrument a circular hole is bored into each beet from its "tail" towards its "head," and approximately half an ounce of pulp is thereby removed. This is polarized for sugar. If the quantity found exceeds a certain limit the hole in the beet is filled with moist clay and the beet is then planted as a "mother," from which a stock of seed is to be secured.

In the fall of 1886, for example, 113,800 beets were selected and each one analyzed during March and April, 1887. About 60,000 fell below the chemical standard. The remaining 54,000, which were found to be above grade, were planted as "mothers." The seed from these "mothers" was harvested in the fall of 1887 and drilled in the spring

* For detailed explanations of methods see Bulletin No. 27 of the Division of Chemistry of the U. S. Department of Agriculture, above referred to.

of 1888 upon the best land to be found in the neighborhood of Quedlinburg. The drilling was purposely heavy and the date of planting late in order to secure large crops of very small beets, known as *sticklinge*. In the spring of 1889 the *sticklinge* were planted on the Dippe farm, and the seed obtained that fall came upon the market in 1890. A commercial supply of pedigreed seed thus requires not less than four years for its production.

Other seedsmen had methods which they believed to be quite as reliable as that just described, and other varieties of beets, too, had good reputations; hence a demand arose in 1880 for a series of competitive trials to furnish official information to sugar farmers.

Comparative tests of varieties.—Co-operative experiments under direction of the Halle Station.—After a few years of preliminary work all seedsmen who saw fit to take part in competitive trials were invited to meet the director of the station at Halle and assist him in arranging the plan and conditions of the tests. The expenses of the work were shared by the parties interested. For the year 1888 they amounted to more than $1,500.

It was agreed that each seedsman should open his store-houses to the station's officers and indicate the particular stock which he wished to place in competition. The officer was to decide whether the stock of seed was large enough to give the test a practical and commercial standing. The supplies of seed thus secured were to be distributed by lot among farmers selected by Professor Maercker to make experimental tests. The seeds were to be known to the experimenters by numbers only. At the time of the harvest all merchantable beets of each test were to be counted and weighed in the presence of a station officer, and one beet out of every hundred obtained from each test was to be put into a sample pile. This insured large samples, in every case exceeding two hundred beets. The samples were to be packed, sealed, and expressed to the station for analysis.

In 1888 twenty-eight different farmers, representing as many different sections of the Province of Saxony, took part in this experiment. Twenty-five different lots of seed were put under trial; these were drawn from stocks descended principally from the two varieties, French and German, already mentioned. Crosses of the varieties and seed from other stocks made up a small part only of the total number. Three of the farmers had facilities for testing, side by side, all of the twenty-five varieties, but upon each of the other farms approximately twelve different varieties only were seeded. Every variety was submitted to at least eleven different experimenters. In other words, each variety of beet entered by the seedsmen for the competition was tested on from eleven to twenty farms, and samples of the product of each variety grown on each farm were analyzed by the station.

Arranging the station's records of results for the year 1888 according to the standard of value accepted at that time, the variety which stood

highest in an average of eleven or more separate tests, contained 15.98 per cent of sugar, while the lowest variety in the series showed 14.38 per cent; that is, the difference between the highest and the lowest of the different grades was only 1.6 per cent. This was a matter of warm congratulation among all interested, and was accepted as proof of the thoroughness of the work accomplished, both by seedsmen and by the station.

In 1889 the German Parliament changed the sugar laws, reducing the rate levied on the beets to one half the former amount. The income to the Government was, however, kept up by imposing a new tax of 1.4 cents upon each pound of *sugar* removed from the factories. The effect of this law was to exactly reverse the order of values of the varieties tested; those rated last under the old law are now rated among the first, and some of the leaders under the old law are now no longer found worthy of further consideration, and have in fact been dropped from Professor Maercker's experiments. The causes of these changes in value are as follows:

The high percentages of sugar, characteristic of the German types of Vilmorin varieties, are invariably accompanied by relatively small crops of beets; hence the sugar yields per acre are low, oftentimes lower by 20 per cent than similar yields from the Wanzleben varieties. The new tax law removes the incentive to sacrifice everything to high sugar tests. It forces the French variety from the German farm and gives the farmer an opportunity to develop his beet growing in a normal direction.

The standard which now influences German seedsmen is "*the highest possible yield of sugar per acre secured in the lowest possible tonnage of beets.*" That under this standard the German varieties and the methods of selection above described are superior, is indicated by the facts that (1) without exception the Klein Wanzleben beets have, during eight years of comparative testing, yielded invariably the larger quantity of sugar per acre; (2) with a decrease in tonnage of beet per acre, amounting to more than 25 per cent, an actual increase in the yield of sugar, exceeding 5 per cent, has been gained. These results apply only to the Wanzleben variety, for with French stocks similar treatment resulted in a decrease in the tonnage of beet of 12 per cent and a decreased yield of sugar per acre amounting to more than 8 per cent.

Points of especial interest for American experimenters.—From the data thus briefly summarized and other experience, it is perhaps safe to say that whatever plant may be selected for the American sugar industry, beet, sorghum or cane, the stations should see to it that all results of varietal tests are brought first to the standard of yield of sugar per acre. With this standard fixed, the purity of juice and the tonnage of crude crop may vary according to business requirements. The publication of analytical figures, and breeding and selection according to chemical

tests alone, may be, under certain conditions, advisable; but as progress is made it will doubtless be found that a relatively low-testing material may have a greater practical value than a higher-testing rival.

Tests made at distant points should not be accepted without corroborative trial. The Vilmorin beet was found unfit for use in Germany owing to its relatively small crops. In Austria the experimental results under Professor Maercker's own directions demonstrated that this variety excelled not only in its percentage of sugar, but also in weight of crop, and in all other respects.

Varietal tests on a single farm have been severely criticised and with good reason. The results above quoted illustrate anew the danger in drawing conclusions from them. Comparing the different varieties by the averages of all the tests of sugar content of each, the highest variety was only 1.6 per cent above the lowest. But the different samples of a single variety, all grown from the same stock of seed, varied from one another by 3 per cent of sugar. In other words, differences due to soil, climate, cultivation, etc., may exceed all differences properly attributed to breeding and selection. For a fair comparison of varieties it is necessary to make a large number of tests and find an approximation to the truth in figures representing averages.

Of the factors which will influence the introduction of the sugar industry in the United States, soil, climate, water, fuel, and labor are matters of locality; that is, they already exist in the right combination in certain favored places. Machinery and seed, on the contrary, are dependent upon human ingenuity, knowledge, and perseverance. Inventors, draughtsmen, and mechanical engineers have simplified the question of suitable machinery for both beet and sorghum sugar extraction and have brought matters to a point where a halt can be called to await improvements in other directions, noticeably in seed selection and in field work upon growing crops.

ABSTRACTS OF BULLETINS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

California Station, Bulletin No. 86, May 17, 1890 (pp. 4).

PRESERVATIVE FLUIDS FOR FRESH FRUITS, E. W. HILGARD, PH. D. (pp. 1–3).—This article was written as an answer to inquiries regarding methods of preserving samples of fruit for exhibition at fairs. In general, the preservative must be an antiseptic liquid which will neither exercise a solvent or softening action upon the skin of the fruit nor extract or change its color; nor differ so in density from the juices of the fruit as to cause the latter to shrink or swell. Alcohol, sugar, glycerine, and salt, while useful as preservatives for some purposes, do not meet all these conditions. Salicylic acid, boracic acid, sulphurous acid, and bisulphite of soda are recommended as antiseptics and the methods of their use described. Attention is called to results of investigations by Prof. P. Pichi, of the Royal Viticultural School, at Conegliano, Italy, with corrosive sublimate (bichloride of mercury) for the preservation of grapes. Professor Pichi's conclusion is, "that grape bunches can be best preserved for collections by keeping them immersed in a solution of corrosive sublimate, taking *special care to wash them thoroughly beforehand.*" The best strength for this solution seems to be 4 *pro mille.* The poisonous nature of this fluid should be taken into account. Tests of this preservative are now in progress at the California Station.

THE SULPHURING OF DRIED FRUITS, E. W. HILGARD, PH. D. (pp. 3, 4).—A résumé of the author's opinions on this subject, which is of considerable importance in California. The sulphuring of dried fruit has two objects: to brighten the color and to prevent the attacks of insects. When freshly sliced fruit is treated with sulphurous acid for a short time the effect on the fruit is comparatively slight, and yet insects are, to a considerable extent, deterred from touching such fruit. When, however, as is often the case, fruit is thoroughly sulphured after drying, the gas penetrates the entire spongy mass of the fruit, bleaching it without regard to its quality, injuring its flavor, and, worst of all, causing the formation of sulphuric acid in sufficient amount to be injurious to health. This last point is enforced by statements of the analyses of sulphured apricots and prunes, in which a specimen of

the former fruit was shown to contain 0.232 per cent of sulphuric acid (equivalent to about 25 grains of oil of vitrol per pound) and the latter 0.346 per cent of sulphuric acid (mostly free). In most European countries the sale of sulphured fruit is forbidden. California fruit growers are advised to make an effort to educate the public taste so that it will prefer "healthy, brown, high-flavored fruit to the sickly-tinted, chemical-tainted product of the sulphur box."

California Station, Bulletin No. 87, June 7, 1890 (pp. 4).

THE CONSERVATION OF WINES, E. W. HILGARD, PH. D.—This bulletin was prepared to combat "irrational prejudices against the treatment of wines by purely physical means," such as are commonly employed in the wine producing countries of Europe, "especially in those in which the prevalence of climatic conditions similar to ours renders the conservation of dry wines *not* fortified a matter of well-recognized and acknowledged difficulty." The process of wine heating or "pasteurizing," direct treatment with an electric current, and the sterilization of wine by filtration through porous porcelain, are described and discussed, principally by means of quotations from foreign sources. An electro-magnetic process devised by Dr. Fraser of San Francisco, is also favorably referred to.

Colorado Station, Bulletin No. 11, April, 1890 (pp. 12).

SUGAR-BEETS, C. L. INGERSOLL, M. S. (pp. 3–6).—In Colorado, where irrigation is practiced, the conditions of soil and climate make it easy to raise large crops of beets. "Not only is the total yield heavy, but single specimens often grow to wonderful size." The dry and clear weather which prevails in this State in the autumn also favors the formation of sugar in the beets. Comparison of climate and other conditions in Colorado with those of the beet-growing regions in Europe is favorable for beet growing in Colorado. The method of culture recommended is as follows:

"(1) Prepare a deep and well-pulverized seed bed.

"(2) Sow in drills 18 to 20 inches apart, so as to admit of horse culture between the rows, using from 7 to 8 pounds of good seed per acre.

"(3) Irrigate judiciously and keep clear of weeds. Cultivate thoroughly during their early growth.

"(4) When well up, thin so that there shall be one thrifty plant every 6 or 8 inches (some say 10 or 12), and take care not to injure the plants in this process.

"(5) In cultivation take care to preserve the leaves and to throw some earth on the plants each time. The portion of the beet which grows above ground does not contain much sugar.

"(6) Harvest when ripe, and preserve free from frost."

An average yield of 25 tons per acre is thought to be a good crop. Three methods of extracting sugar from beets are discussed, and suggestions made and quoted as to the practical methods of beet growing and sugar making.

CHEMICAL ANALYSES OF SUGAR-BEETS, D. O'BRINE, D. SC. (pp. 7-12).—The experiments with sugar-beets at the station, begun in 1888 and reported in Bulletin No. 7 (See Experiment Station Record, Vol. I, p. 13), were continued in 1889. "In 1889 it was proposed to grow beets on poor (unfertilized) soil and on rich (fertilized) soil, and to note the difference, if any, in the substances present in the ash, to compare the specific gravity of the expressed juice and the per cent of sugar present." An early frost prevented proposed investigations of the relation of the sugar content in the beet to the weight of tops and of the feeding value of tops. Five specimens of beets were analyzed, two of Silesian, two of Imperial (one of each grown in rich and one in poor soil) and one of Vilmorin. The results are stated in tables. The per cent of the sugar in the juice was in one case larger and in the other smaller in the beet grown in rich soil than in the beet grown in poor soil, and the same was true of the water. The per cent of sugar was determined in sections of specimens of the Silesian and Imperial beets, and the results are given in a table, which includes data for the percentages of grape, cane, and total sugar. The sections were made across the beet, 1 inch apart, from the top down.

The percentage of sugar increased steadily, except in a single case, from the top to the lowest section. Determinations of the water and nutritive ingredients, and analyses of the ash in the five specimens were made. In general it was found that the percentage of ash was greater in the beets grown on the rich soil, and that the percentages of iron, aluminum, calcium, and phosphoric acid in the ash were greater in the beets from the poor soil. The specific gravity of the expressed juice of the beet was not a correct index to the per cent of sugar present in the specimens. There was a somewhat regular increase in sugar content from the top of the beet downward. The average per cent of sugar present in the experimental crop of 1889 (9.98 per cent) was but little less than in that of 1888 (10.45 per cent), but the greater yield of beets per acre in 1889 more than compensated for the smaller per cent of sugar.

Connecticut State Station, Bulletin No. 103, May, 1890 (pp. 14).

FERTILIZERS.—This contains brief statements regarding the duties of dealers under the Connecticut fertilizer law; the conditions under which gratuitous analyses are made by the station; a list of manufacturers who have complied with the provisions of the fertilizer law, with the names of the brands for which fees have been paid for the year ending May, 1891; the trade values for 1890 of fertilizing ingredients in raw

materials and chemicals, as agreed upon by the stations in Connecticut, Massachusetts, and New Jersey; and reports of analyses of nitrate of soda, sulphate of ammonia, dried blood, cotton-seed meal, castor pomace, sulphate of potash, muriate of potash, cotton-hull ashes, precipitated phosphate, dissolved bone-black, ground bone, tankage, sea-weeds, sponge, pigeon manure, and fish guanos.

Florida Station, Bulletin No. 9, April, 1890 (pp. 16).

ENTOMOLOGICAL NOTES, J. C. NEAL, M. D.—Brief notes compiled from different sources, including the author's observations, on the root knot worm (*Heterodera radicicola*), cut-worms, cotton worm (*Aletia argillacea*), boll-worm (*Heliothis armigera*), cotton stainer (*Dysdercus suturellus*), leafy-legged plant bug (*Leptoglossus phyllopus*), locust cossus (*Cossus* [*Xyleutes*] *robiniæ*, Peck), anisota worm (*Anisota senatoria*), stinging slug (*Lagoa opercularis*), rascal leaf-crumpler (*Acrobasis* [*Phyceta*] *nebulo*), twig girdler (*Oncideres cingulatus*, Say.), flea beetle (*Graptodera* [*Haltica*] *chalybea*), strawberry beetle (*Haltica ignita*), procris worm (*Procris americana*), imported cabbage butterfly (*Pieris rapæ*), and orange scale insects. Directions for preparing various insecticides are also given.

Iowa Station, Bulletin No. 9, May, 1890 (pp. 50).

COMPARATIVE VALUE OF FODDER PLANTS AND OTHER FEEDING STUFFS, R. P. SPEER (pp. 343–354).—In this article attention is called to the close competition now existing in the business of farming and to the necessity of skill in breeding and feeding animals if satisfactory profits are to be obtained. To aid the farmers of Iowa in the adoption of better systems of feeding, explanations of the technical terms used in the statement of analyses of feeding stuffs are given, together with compiled tables showing the percentages of digestible nutrients, and pounds of each group of these nutrients per ton for the forage plants and other feeding stuffs commonly used in Iowa, and for a few others that promise to be of value there; and a table of feeding standards (German), with explanations of the utility of such tables and advice regarding the relative value of the different feeding stuffs.

IOWA STATION MILK TEST.—A CORRECTION, G. E. PATRICK, M. S. (p. 355).—A correction of some minor errors of statement which had crept into an article in Bulletin No. 8 (p. 307) of this station.

THE RELATIVE VALUE PLAN AT CREAMERIES, G. E. PATRICK, M. S. (pp. 356-369).

Preserving milk samples for testing.—"The pooling system of purchasing milk, now universally practiced at separator creameries, is defensible only on grounds of expediency, as a makeshift to be endured only until a better system shall be developed. It makes no pretense to justice in its treatment of the individual patron; it places a premium on quantity

rather than quality and even at the expense of the latter; it drives patrons possessing rich-milk dairy herds and those who feed liberally and intelligently into private dairying; it tempts the short-sighted and cunning into dishonest practices; and tends in every way to demoralize the creamery industry.

"The relative value plan, *i. e.* that of paying each patron according to the quality as well as the quantity of his milk, is sure sooner or later to supplant the present irrational system. The difficulty is the large amount of work supposed to be of necessity incident to it." A just system would require that all the milk received at the creamery should be sampled, tested, and valued. Under ordinary conditions so much time and labor would be required as to make it impracticable, but as the result of the experimental inquiries reported in this bulletin the author proposes a plan by which, in his belief, a large amount of labor can be avoided. It may be outlined as follows:

"Put the daily sample for each patron in amount proportional to his daily deliveries, successively, as taken at the weigh tank, into a receptacle containing a small amount of some efficient preservative which will not interfere with the subsequent testing of the composite sample, and after a certain number of days—say seven or ten—ascertain by a single test the average quality of the patron's delivery for that period." Objections to this plan are considered, and details of experiments are given for finding a preserving agent and testing its value.

"The method employed for testing the milk, fresh and preserved, is that described in Bulletin No. 8 of the station, under the name of 'The Iowa Station Milk Test' (See Experiment Station Record, Vol. II, p. 52). It is quite likely that any preservative whose presence does not interfere with the working of this test may be used without hindrance in the method of Short—but in the absence of trials no positive statement can be made." For the preserving agent three qualities are essential:

"(1) It must be an efficient preservative, holding unchanged the fat content of the milk for the desired length of time.

"(2) It must keep the sample in good mechanical condition, *i. e.* it must neither curdle the milk nor allow curdling to take place, nor allow the cream which rises in the sample to form a tough pellicle, difficult of uniform distribution throughout the liquid by gentle agitation.

"(3) It must not interfere with the working of the method by which the milk is to be tested."

In the trials here reported the agents, alone or in combination, giving a more or less encouraging result are: carbolic acid, salicylic acid, salicylate of soda, benzoate of soda, boric acid, mercuric chloride (corrosive sublimate), arsenic acid, arsenious acid, and alcohol. "Of this list the only ones that have proved in all respects satisfactory are those containing mercuric chloride and these have invariably been almost perfect in their performance."

Mercuric chloride was dissolved in water and the concentrated solution colored with "aniline rose pink, 3 B." This solution and one containing common salt and holding more of the mercuric chloride but colored as deeply as the first, were used as preservatives. Samples of milk to which these were added were kept in the laboratory from seven to thirty-three days at a temperature varying from 55° to 75° Fah. The percentages of fat were determined at the beginning and end of each trial. Fourteen trials were made with the first and eleven with the second solution. The results, given in detail, imply that 10 to 15 grains of mercuric chloride are sufficient to preserve 200 to 400 cubic centimeters (one fifth to two fifths of a quart) of milk in a warm room in winter so that the determination of fat by the author's method is not interfered with. A serious objection to the use of the corrosive sublimate is that it is a violent poison. For this reason the author does not care to recommend its general use in creameries, and hopes that in the future some harmless preservative will be found. A plan for the practicable application of the author's method is given in detail. It is now being used in a creamery at Brandon, Iowa.

Table of relative values.—To facilitate the adoption of the relative value plan a table is given which may be used in calculating the prices of milk per 100 pounds, with directions for the use of the table. This table is similar to that published in Bulletin No. 16 of the Vermont Station.

PLUM CURCULIO AND PLUM GOUGER, C. P. GILLETTE, M. S. (pp. 370–388).

Plum curculio (*Conotrachelus nenuphar*).—Observations by the author in 1889 with reference to the breeding of this insect in Iowa are reported. The results agree with those of other observers in showing that "the curculio is not double brooded in Iowa, but the eggs deposited late in July and August are from belated females." A tabulated record is given of the fruit injured by the curculio on trees of four imported and seven native varieties of plums. The per cent of fruits injured in the case of the imported varieties varied from 14 to 66 and averaged 46.8; for the native varieties it varied from 2.5 to 25.8 and averaged 6.6. Analyses of specimens of five varieties of plums, made by the station chemist, are recorded, which show percentages of water varying from 75.3 to 85.5. In connection with the observations on the curculio, these analyses indicate that "the succulent, quick-growing plums are not less attacked than slow-growing varieties."

Observations of the action of the curculio on the Duchess apple are also reported, and the curculio parasite (*Sigalphus curculionis*) is illustrated and briefly described.

Records of two applications of London purple (May 4 and 11) indicate that "although not made at the times best suited to destroy the curculio, they apparently gave a protection of 44 per cent against the ravages of this insect."

Plum gouger (*Coccotorus prunicida*, Walsh).—This includes a brief illustrated description of this insect and an account of its life history, with special reference to observations by the author; a record of experiments with London purple for this insect; and brief notes on *Sigalphus canadensis*, a parasite which was observed to prey on the gouger. The following summary is taken from the bulletin:

(1) The gouger appears upon the trees much earlier in the spring than does the curculio.

(2) The gouger is much more injurious than the curculio to native plums on the grounds of the Iowa Agricultural College.

(3) The gouger very much prefers the native to the domestic varieties.

(4) The examination of over twenty-four thousand native plums, from not less than eighteen different trees of many varieties, showed a little over 27 per cent of their fruit to be injured by the gouger.

(5) The gougers take no food in the fall after emerging from the plums.

(6) The gouger has at least one parasite that preys upon it while in the pupa state. The parasite is *Sigalphus canadensis*.

(7) The season's experiments indicate that London purple, as recommended for the destruction of the curculio, is of little value for the destruction of the gouger.

(8) The gouger is not able to come to maturity in fruit that falls from the trees before the middle of July.

(9) Fruit infested by the gouger does not ripen or fall prematurely.

(10) About 26 per cent of the punctures of the gouger result in the production of a beetle.

(11) Jarring the trees, collecting the beetles, and gathering stung fruit from the trees before the 1st of August are the best remedies at present known for the gouger.

London purple for plum-trees.—As the result of his experiments the author holds that 1 pound of London purple to 240 gallons of water makes a solution sufficiently strong as an insecticide and safe to use on plum-trees.

Massachusetts Hatch Station, Bulletin No. 8, April, 1890 (pp. 24).

Greenhouse heating—steam versus hot water, S. T. Maynard, B. S. (pp. 3–5).—A careful repetition of the experiments reported in Bulletins Nos. 4 and 6 of this station (See Experiment Station Record, Vol. I, pp. 82 and 225) confirmed the results previously obtained in favor of the hot-water system. The two greenhouses are alike except that one is heated by hot water and the other by steam. From December 1, 1889, to March 18, 1890, for the hot-water boiler 6,598 pounds of coal were consumed to maintain an average temperature of 49.74° Fah.; for the steam-boiler 9,784 pounds of coal were consumed to maintain an average temperature of 48.39° Fah. Objections to the experiments are considered and the correctness of the conclusions is maintained. Thermometric observations of "sun temperatures" in the two houses are cited.

Observations on peach yellows, S. T. Maynard, B. S. (pp. 6–12, illustrated).—In New England peach trees do not generally maintain healthy growth beyond the age of six to ten years. The chief difficulties are cold and the disease called "yellows." Whether this dis-

ease is due to a specific germ or microbe is not settled. It may be of a similar nature to pear blight and other kindred diseases, and perhaps the same as that which often destroys the wild cherry, wild plum, and sweet birch. There is no evidence that it is contagious. The symptoms of this disease are briefly stated, and reference is made to previously reported experiments in a small peach orchard on the college grounds by Professors Goessmann and Penhallow and the author. The conditions favorable to this disease are believed by the author to be improper food supply, and injuries by cold, by the peach borer (*Ægeria exitiosa*), and by any accident which reduces the vigor of the tree.

(1) *Food supply.*—"In almost every case investigated where the trees are neglected and the food supply is small, the trees soon die, many of them showing unmistakable signs of the yellows, while where the food supply is abundant and of a kind suited to perfect development the growth is vigorous and healthy, and the trees often live from fifteen to twenty years.

"Too large an amount of nitrogenous manure, especially if applied so that the trees do not get the benefit of it early in the season, results in a late, immature growth of wood, that is often seriously injured by cold during the winters, and this is followed the next season by signs of the yellows.

"The fertilizers recommended are equal quantities of muriate of potash and nitrate of soda, with about four times the weight of fine ground bone, applied in March or April, from 5 to 10 pounds to the tree, according to size. Wood ashes 5 pounds, ground bone 2 pounds, with from one half to one pound of nitrate of soda to each medium sized tree, will also prove very satisfactory. If the land is poor, containing little organic matter, a liberal dressing of stable manure may be applied in the fall; but if the land is not *very poor*, chemical manures will give better results. All manures or chemical fertilizers should be applied so that the trees may get the benefit of them early in the season. If very soluble, they should be put on in March or April, but stable manure or ground bone should be put on in the fall."

(2) *Injury by cold, borers, and accident.*—When a late growth of the trees occurs from any cause, as from too much nitrogenous manure applied late in the season, or from a warm, late fall, the action of frost during the winter often breaks the tissues in such a manner that they can not be repaired during the next season's growth, and dead places are often found on the trunk and main branches. These conditions are very common in trees from eight to ten years old in most orchards of New England. Injuries of a very similar appearance more frequently occur as results of a decay of the tissues about the holes made by the peach borer. The question is suggested whether these and other injuries result in the yellows, and observations are cited which imply that they do.

How far may a cow be tuberculous before her milk becomes dangerous as an article of food? H. C. Ernst, M. D. (pp. 13–24).—This is a preliminary report on investigations undertaken under the auspices of the Massachusetts Society for Promoting Agriculture. The infectious character of tuberculosis is discussed with special reference to the question whether the milk from cows with no definite lesion of the udder can be shown to contain the virus of tuberculosis. It is urged that, "as is well known, one seventh of the human race approximately perish from this disease." Among the means by which the virus is spread "are undoubtedly the excreta—more especially the sputum—from persons affected with the disease," and "the ingestion of food materials coming from the domestic animals, especially the flesh and milk of cattle." Experiments were conducted by the author with cows especially selected and kept in frame buildings which were in a healthy locality and had been very carefully cleaned and disinfected. Only the main features of the experiments are reported in this bulletin.*

All of the inoculation experiments and most of the microscopic work have been done in the bacteriological laboratory of the Harvard Medical School, some of the microscopic work at the Society's laboratory in Boston, whilst the feeding experiments have been done and the experimental animals have been kept at a farm in the country devoted to this especial purpose, and situated among the healthiest possible surroundings. Nothing has been set down as the result of microscopic observation that I have not myself verified, and every portion of the work has been carried out under the most exacting conditions and with every possible precaution against contamination. * * * The observations have been carried on over a long space of time, and were made as follows: The milk was taken from the cow in the morning or evening, as the case might be—the udders and teats having just been thoroughly cleaned. The receptacle was an Erlenmeyer flask, stoppered with cotton wool and thoroughly sterilized by heat. The specimen was taken at once to the laboratory, there placed in conical glasses, with ground-glass covers—the whole of these having been carefully cleansed beforehand—and then allowed to stand in a clean refrigerator for twenty-four to forty-eight hours, and sometimes for seventy-two hours.

At the end of that time from ten to twenty cover-glass preparations were made from various parts of the milk or cream. These were stained after Ehrlich's twenty-four-hour method, with fuchsin and methylene blue as a contrast color, and then searched with an immersion lens.

[The examination was completed for one hundred and fourteen samples of milk from thirty-six cows,] all of them presenting more or less distinct signs of tuberculosis of the lungs or elsewhere, but none of them having marked signs of disease of the udder of any kind. Of these samples of milk there were found seventeen in which the bacilli of tuberculosis were distinctly present; that is to say, the actual virus was seen in 10 [nearly 15] per cent of the samples of milk examined. These seventeen samples of infectious milk came from ten different cows, showing a percentage of detected infectiousness of 27.7 per cent.

These percentages are thought by the author to be clearly within the limits of accuracy, since the amount of dilution greatly diminishes

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* The details may be found in the Transactions of the Association of American Physicians, Vol. IV, 1889. Austin Peters, D. V. S., veterinarian of the Massachusetts Society for Promoting Agriculture, Dr. Henry Jackson, and Langdon Frothingham were associated with the author in this work.

the probability of their being found at all. That is to say, as the result of microscopic examination of the milk of these cows, which were tuberculous but showed no marked signs of disease of the udders, it appeared that the milk of more than one fourth of the cows and more than one seventh of all the samples of milk contained the bacilli of tuberculosis.

Other interesting facts shown by the experiments are that the cream after rising is quite as likely to be infectious as the milk; the bacilli are present with a fair degree of constancy; the bacilli if present at all in the udder are not washed out entirely in the first part of the milking, but may be present in any portion of the milk, and even after the milking, the bacilli may be supposed to be pretty evenly distributed in all parts of the udder.

Inoculation experiments were made with rabbits and guinea-pigs. The milk of seven cows out of the fourteen used for the purpose was thus shown to be infectious. Microscopic examination of material from calves fed on milk from cows affected with tuberculosis, revealed infection in five out of twelve cases in which positive results were obtained. In similar experiments with pigs results showing infection were obtained in two out of five cases.

The following conclusions are drawn at this stage of the work: "(1) Emphatically, that the milk from cows affected with tuberculosis in any part of the body may contain the virus of the disease. (2) That the virus is present whether there is disease of the udder or not. (3) That there is no ground for the assertion that there must be a lesion of the udder before the milk can contain the infection of tuberculosis. (4) That, on the contrary, the bacilli of tuberculosis are present and active in a very large proportion of cases in the milk of cows affected with tuberculosis but with no discoverable lesion of the udder."

Massachusetts Hatch Station, Special Bulletin, May, 1890 (pp. 44).

ON THE MOST PROFITABLE USE OF COMMERCIAL MANURES.—A translation by Prof. Charles Wellington of an article by Prof. Paul Wagner, director of the agricultural experiment station at Darmstadt, Germany.

Michigan Station, Bulletin No. 60, April, 1890 (pp. 10).

FEEDING PIGS OF DIFFERENT BREEDS, E. DAVENPORT, M. S. (pp. 3–7).—This experiment was a duplicate of a similar test made at the college in 1888, "which was undertaken at the request of leading breeders, with a hope that it would give some evidence as to the comparative value of some of our breeds of swine for pork production." Two barrow pigs of each of the Duroc Jersey, Berkshire, and Poland-China breeds were fed one hundred and sixty-eight days, from July 16, 1889, to December 31, 1889. The food consisted of "equal parts of corn and oats ground together and mixed with twice its weight of fine middlings,"

except that during two periods of nine and seven days fine middlings alone were fed. The pigs were weighed every fourteen days during the experiment.

Details are given in two tables, and a recapitulation of results of a similar experiment in 1888 in a third table, from which the following is compiled. The figures for total feed consumed, weights of animals, and gains in weight are for two animals in each case.

Summary of experiments of 1888 and 1889 with pigs of different breeds.

	Age in days at beginning of experiment.	No of days of experiment	Total feed consumed	Cost of feed consumed.	Weight at beginning of experiment.	Live weight at end of experiment	Live weight at end of experiment, after shrinking 24 hours	Shrinkage before killing		Ratio of dressed to live weight, not shrunk	Gain in live weight, not shrunk.	Food consumed per pound of gain in 1888 (140 days)	Food consumed per pound of gain in 1889 (168 days).
			Lbs.		*Lbs*	*Lbs.*	*Lbs.*	*Lbs*	*Per ct*	*Per ct*	*Lbs.*	*Lbs.*	*Lbs.*
Durocs:													
1888	......	140	2,292	.....	241	731	.. ..	..	....	84	490	4 67	......
1889	78	168	2,028	$14 20	114	549	505	44	8	76	435	.....	4.65
Berkshires:													
1888	.... ..	140	1,581	.....	137	536	.... .	...	......	82 84	399	3.97	......
1889	103	168	1,853	12 97	186	541	527	14	2 6	81 3	355	......	5.22
Polands:													
1888	......	140	1,841	.....	168	585	...	..	..	83-85	417	4 41	......
1889	88	168	1,827	12.79	159	470	446	24	5.1	81 5	311	.....	5 87

The detailed figures for the experiment of 1889 show the weights of animals and apparent gains in weight, weights of food consumed, apparent daily gain, and feed for 1 pound of gain for each fortnightly period. They show wide irregularities (doubtless attributable in the main to differences due to the individuality of the animals and to the weights of the contents of the alimentary canal). In general, the gain in live weight for a given amount of food decreases with the age of the animals, as has been found to be the case in other experiments.

The results of weighings of the different parts of the animals when slaughtered—viscera, liver, lungs, heart, kidneys, tongue, and "weigh-lard," are given.

The following are among the points to which attention is especially directed in the summary of results of the experiment of 1889:

There is a great difference in the shrinkage in live weights of the different lots before slaughtering. There are no less than three weights that might be made the basis on which to compute the profits of feeding, viz.: (1) the live weight at the close of feeding; (2) the live weight after shrinking twenty-four hours; (3) the dressed weight, each giving an independent and different result. The experiment has to do with *gains*, not total weights, and while the shrunk and dressed *weights* are known, the shrunk and dressed *gains* are not known, and could

be only approximately computed, however desirable they may be. Could the shrinkage be properly accounted for much of the apparent difference in feeding ability would disappear. The proportions of dressed weight to *shrunk* live weight do not vary greatly except in one case.

Had the experiment terminated a month before, the consumption of food for each pound of gain would have been greatly different and altogether more uniform, as between the breeds, viz., Durocs 4.57, Berkshires 4.84, and Polands 5.15. The Polands were past their best, and the Berkshires improving but slowly, while the Durocs showed every sign of being able to feed much longer at the end of the experiment.

The meat of the different breeds was cooked and was tested by a number of persons, and it was their "unanimous opinion" that the meat of the animals which were making the greatest gains was sweeter and tenderer than that from the others. "One of the most important questions suggested is believed to be the one of the possible relation between the quality of meat and the condition of growth of the animal at the time of slaughter. If an animal should be slaughtered while still making good gains let us know it."

[On the whole these experiments do not answer the specific question as to relative merits of the breeds for which an answer was desired by the "leading breeders." Indeed, as urged by the author, and for other reasons, such trials in the nature of the case can not answer questions which involve conditions so complicated.

The differences in individuality of the animals require tests with large numbers of each breed. The effects of different foods and methods of feeding, the rapidity of growth, the character of the product, and other factors are important. And to get accurate data regarding the effects of the food, the variations in live weight of the animals, due to differences in the contents of the alimentary canal, must be eliminated. The latter from the meconium at birth, to the water and more or less completely digested food and food residue at time of slaughter, are subject to notable variations. Two plans are available for the solution of the questions. One consists in feeding experiments with a large number of animals, in which weighings and analysis shall be made of the different parts and organs at the beginning and the end of each trial, and of food and undigested residue. These may be carried out with sufficient detail and thoroughness to bring decidedly useful results. The other is by more refined methods, which are employed with the respiration apparatus. These are requisite for the highest accuracy of results.]

TESTS OF VARIETIES OF VEGETABLES, E. DAVENPORT, M. S. (pp. 8-10).—Tabulated notes on 37 varieties of potatoes, 6 of carrots, 7 of mangels, 2 of beets, 5 of ruta-bagas, and 14 of silage corn. The notes on the potatoes include estimates on a scale of 10 of the color, grain, mealiness, and flavor of the different varieties as tested by eight dif-

ferent families. It is found at this station, as elsewhere, that the smaller sorts of corn, yielding a relatively large proportion of ears, are better for silage than the large, watery varieties destitute of ears.

Michigan Station, Bulletin No. 61, April, 1890 (pp. 8).

FOUL BROOD, A. J. COOK, M. S.—This includes popular accounts of fungoid diseases and bacteria in general, and of the species *Bacillus alvei*, causing foul brood in bees, the symptoms of the disease, and suggestions as to its prevention or cure. "It goes without saying that we should be very careful not to introduce combs or honey from diseased colonies into our apiaries, or permit our bees to gain access to such comb or honey; neither is it best to get bees from foul brood apiaries, for though it would seem that the bees can not convey the malady, yet it might come in comb or honey. For like reason, in case foul brood comes into our bee yards, we must quarantine all diseased colonies, and spare no pains to prevent the bees from healthy colonies getting either at the honey or comb from the foul-brood hives."

Burning or burying all diseased colonies is not deemed necessary to control the disease. Dilute solutions of salicylic acid and of carbolic acid have been successfully used. "If the bees are simply run into clean, untainted hives, either upon foundation or empty frames, they escape the disease and are cured."

There is also a brief account of a "nameless bee disease," which attacks mature bees, causing them to "look black because of loss of hair, much as do robber bees or old bees in spring, and to frequently make strange motions in front of the hives, as though dancing or in convulsions. This disease is also supposed to be due to a fungus (*Bacillus gaytoni?*), and apparently inoculation comes through the queen, for the malady disappears when a healthy queen is substituted for a diseased one. "It is also reported" that if the diseased bees have access to an "abundance of salt water placed near the hives" they will be cured.

Michigan Station, Bulletin No. 62, May, 1890 (pp. 8).

THE ENGLISH SPARROW, C. B. COOK, B. S. (illustrated).—This contains brief accounts of the injuries inflicted by the English sparrow (*Passer domesticus*), descriptions of this bird and of species of birds which are liable to be mistaken for the sparrow, and suggestions as to means for the repression of this pest. In Michigan a bounty of 3 cents is paid for each sparrow's head delivered to a town clerk, but as many of these officials are not able to distinguish a sparrow's head from that of a linnet or thrush or other valuable bird, the law seems to have promoted an indiscriminate slaughter of useful birds. "It is hoped that the descriptions and illustrations of this bulletin will enable any town clerk to identify the birds." Should any clerk still be in doubt, he is invited to send the birds to the station for identification.

Nebraska Station, Bulletin No. 13, April, 1890 (pp. 81).

EXPERIMENTS IN THE CULTURE OF THE SUGAR-BEET IN NEBRASKA, H. H. NICHOLSON, M. A., and RACHEL LLOYD, PH. D.—In 1872, beets raised on the farm of the Industrial College for stock feeding, were found by analysis to contain over 15 per cent of sugar. Apparently no further investigations in this line were made in Nebraska until the spring of 1888, when a systematic experiment was begun by persons in and near Grand Island, to find whether beets could be raised in that locality with sufficient sugar content to warrant the investment of capital in a sugar plant at that place. The results of the experiment, including those of analyses at the station and elsewhere, were so satisfactory, that in 1889 the station undertook to carry on investigations in this line throughout the State. Farmers planting either sugar-beets or sugar-cane in 1889 were requested to report to the station regarding, (1) kind and variety of seed planted, (*a*) sugar-beet, (*b*) sugar-cane; (2) number of acres planted; (3) date of planting; (4) kind of soil; (5) method of cultivation; (6) time of harvesting, yield per acre; (7) cost per acre, price per ton at factory; (8) kind of season. Seeds of Lane's Imperial and Vilmorin varieties of sugar-beets were distributed among farmers in different parts of the State, and other varieties were also tested in some places. The station co-operated also with the State Bureau of Labor and Statistics, which furnished beets for analysis. Analyses of one hundred and sixty-six specimen beets, grown by over sixty different persons, in thirty-seven counties, representing all sections of the State, are reported in detail in the bulletin and summarized in a table filling nearly six closely printed pages. Besides Vilmorin and Lane's Imperial the following varieties were analyzed: Percy's White, White Sugar, Improved Imperial, Silesian, and Wanzleben. In some cases ten specimens and in others only one was taken for analysis from each experiment. The time of planting ranged from April 4 to June 15, but was usually in the early part of May. The crop was harvested in October. Almost all the experiments were on loamy soil. Apparently little attention was paid to methods of cultivation. The data given in the table include the name and post-office address of grower, variety of beets, time of planting and harvesting, kind of soil, amount of cultivation, average temperature and rain-fall, and number of rainy days for each month of the season of growth, weight of the beet analyzed, total solids, per cent of sugar (sucrose and glucose), and purity. The following explanations of some of the terms used in the table are taken from the bulletin:

In the column "total solids" is written the entire amount of solid matter, sugar, and other substances in 100 parts of the juice. Under "per cent of sugar" are two columns: the one "sucrose," the other "glucose." The figures indicate the amount of each in 100 parts of juice. By sucrose is meant our ordinary crystallizable sugar; by glucose we mean a less sweet sugar. In the column marked "purity" is recorded

the percentage of sucrose in the entire amount of solid matter in the juice. To illustrate: Beet number 130, grown by Henry Nagle, Antelope County, gives the following record: total solids, 23 7; sucrose, 22.08; glucose, 0.38; purity, 93. This means that in every 100 parts of the juice of this beet there were 23.7 parts of solid matter. This solid matter is composed of—sucrose, 22.08 parts; glucose, 0.38 parts; solids (not sugar), 1.24 parts; total, 23.70 parts. That is, 93 per cent of all the solids is sucrose.

The importance of climate as a factor in the cultivation of sugar-beets led to the collating of information regarding the climatic conditions essential to the production of sugar-beets in Europe and comparisons with similar data obtained from different parts of Nebraska.

A summary of the climatic conditions prevailing in Europe where sugar-beets are raised, is reprinted from Special Report No. 28 of the United States Department of Agriculture. Sugar-beet culture in Europe prevails largely in the north. Though the quantity of rain-fall is greater in the south, yet vegetation in that section suffers more from lack of moisture than in the north. This has been explained as the result of the more rapid evaporation of moisture in the south, due to a higher temperature, more direct sunlight, and a less number of rainy days. A chart of the temperature and rain-fall curves for the summer months in the beet-growing districts of Europe is given, as well as a table and charts of the temperature and rain-fall for the same months in Nebraska, compiled from the records of the Nebraska weather service and the meteorological department of the station. "Statistics from forty counties in the State are thus presented, extending over periods of from one to eighteen years."

A comparison of these results with those of the sugar-growing districts of Europe, and with those climatic conditions apparently required for successful sugar production, shows a close correspondence. In the sugar-producing districts of Europe the average monthly temperature for the months of May, June, July, August, and September does not rise above 70° Fah. nor fall below 50° Fah., whilst the average monthly rain-fall for the same period of time does not fall below 1.5 inches nor rise above 4 inches. The conditions required for successful culture in Europe, as given by Briem, are, in general, comparatively dry and warm spring months during the time for preparation of soil, planting, and cultivating the crop; moderate temperature; abundant and frequent rains during the summer, the time for the ultimate development of the crop and its valuable constituents; cool and dry fall, the time for ripening, harvesting, and storing the crop.

The average monthly temperature of Nebraska for the months of May, June, July, August, and September ranges between 58.9° Fah. in May to 75° Fah. in July, falling to 62.3° in September, with an average of 69.5° Fah. for the five months; a slight increase of temperature over that prevailing in Europe.

The average monthly rain-fall in Nebraska for the same months ranges from 3.74 inches in May to 4.2 inches in July, falling to 2.14 inches in September, with a summer average of 3.31 inches. It will be noticed that rain-fall and temperature for corresponding periods of time is slightly higher in Nebraska than in the sugar-beet districts of Europe.

Appended is a chart of the temperature and rain-fall in Nebraska, on which is placed for comparison the curves of temperature and rain-fall of the sugar-producing districts in Europe.

These curves show plainly that our temperature and rain-fall are both somewhat higher than in Europe; they also show that these two factors are more closely cor-

related, increasing and decreasing together more evenly. It is possible that in this correlation, within certain limits, we may find a more important factor in the solution of the sugar problem in this State than is found in the limited range of temperature and rain-fall in Europe. Only continued experiment and observation can determine this point.

The distribution of this rain-fall through the months in question is indicated in a table giving the number of rainy days in each of the months, at stations of the Nebraska weather service in thirty-three counties. For purposes of comparison a tabulated statement is given of the number of rainy days in each of the summer months in the sugar-beet district of Belgium, as compiled by Professor McMurtrie in the report of this Department above referred to.

Stated briefly, our rain-fall is greater than it is in the sugar districts of Europe, and falls in fewer days; our temperature is slightly higher, but is closely correlated to the rain-fall; both rain-fall and temperature decrease in September, a condition that in itself is conducive to the formation of sugar in the beet; the number of sunny days is about one third greater here than there. How these modifications of essential conditions will affect the sugar content of beets must be determined by continued experiment in various parts of the State in the raising of beets from good seed and under the best conditions of culture.

Sugar content.—Probably the most important factor, in the estimation of one who is looking forward to the raising of sugar-beets as a possible business, is the amount of sugar found in the beets raised in Nebraska during this year.

An examination of the column headed sucrose (Table 1) shows that the sugar content varies, to a marked extent, from 2 to 22.28 per cent. Out of the one hundred and sixty-six samples of beets analyzed there are sixty-one in which the sugar content is 12 per cent and over. As has been already intimated, the beets that are rich in sugar do not represent any one particularly favored locality, but may be looked upon as fairly representing the entire State, as far as differences in soil and in climatic conditions are concerned.

Since it is very important to secure the greatest possible uniformity in the sugar content of beets, the conditions deemed essential to secure this end in those countries where the sugar-beet industry is most highly developed are compared with the conditions under which the beets were grown in the experiments in Nebraska. In France and Germany the seed used is produced from beets rich in sugar content and grown in the locality where it is to be planted. As early a date of planting as the temperature of the soil will allow is necessary. From the selection of the seed to the harvesting of the crop the greatest care and skill are employed to obtain beets rich in sugar and uniform in quality. In Nebraska, on the other hand, the seed, while not necessarily poor, was, in nearly every case, used without reference to its adaptability to soil or climate. The time of planting, as before stated, ranged from April 4 to June 15. Not only were most of the growers unacquainted with the best methods of sugar-beet culture, but in many cases ordinary cultivation was only sparingly given. The only exception to these conditions was in the case of the farmers about Grand Island. The results of their experience and knowledge may be seen in the uniformly high percentages of sugar in their beets. In the experiments reported from

twenty counties the total solids in the juice ranged from 14.7 to 23.7 per cent; the sucrose from 12.16 to 22.08 per cent; the glucose from 0.006 to 0.87 per cent, and purity from 53 to 94 per cent. The percentage of total solids in the nine samples from Grand Island was in one case 17, in the others 23.7. The sucrose ranged from 13.52 to 21.41 per cent; the glucose from 0.08 to 0.296 per cent; and the coefficient of purity from 59 to 90.

Seed, cultivation, and manuring.—It appears from the table that practically only two varieties—Lane's Imperial and Vilmorin—produced beets of a high sugar content, and that most of the beets were of the latter variety. The beets of small size and light weight were richest in sugar. Conversely, with richness in sugar we find small beets and light weight. Of the sixty-one beets whose juice contained over 12 per cent of sugar, only sixteen weighed as much as two pounds each. "Experience has shown that a beet of regular form, rather long and tapering, is, other things being equal, best adapted to the production of sugar." Illustrations are given of a large, coarse, woody beet containing a small percentage of sugar, and of a small, smooth beet with a long, tapering body, belonging to a variety the average sugar content of which is high.

A tabular statement of the analyses of certain German, French, and Nebraska soils is given to illustrate the fact, now well known, that methods of cultivation are of much greater importance than the chemical composition of soils in the growing of sugar-beets. "Deep, mellow, well-drained soils are theoretically the best for beet-sugar growing. Such soils are easily permeable by air and moisture; are readily affected by drought; and offer but little resistance to the downward growth of the root. Heavy clay soils, and new and very rich soils that are underlaid by a stratum which does not permit the surplus water to drain off readily, are not well adapted to the production of sugar-beets for sugar."

A loamy soil, usually sandy loam, was generally used for sugar-beets in Nebraska in 1889, and the grower is recommended to plant on old, cultivated, light soils. Deep plowing and thorough pulverization, *i. e.* "garden cultivation," is required to produce beets rich in sugar.

The best methods of cultivation and manuring for sugar-beets in Nebraska must be learned by experience, but in gaining this experience the authors wisely think we should take advantage of what has been done in this line in Europe. To give the farmers in Nebraska information concerning the methods of sugar-beet culture abroad, extracts from Special Report 28, of this Department, are given at considerable length.

Yield and cost.—Inasmuch as no definite information from Nebraska farmers on these points was available, experience in California is cited. Instances are given in which the profit per acre ranged from $37 to $69.

It is recommended that "during the coming season those interested in the sugar-beet question, who plant seed, shall in all cases plant measured plats, one tenth, one half, or one-acre lots. Then by keeping an

accurate account of all time and labor applied to the crop and a record of the quantity of beets raised we can approximate very closely next year to cost, yield, and profit, when beets are cultivated on a large scale as a matter of business."

A map of Nebraska is given showing the distribution of the beet-culture experiments in that State. The bulletin also contains the text of an act of the State legislature approved March 19, 1889, for the encouragement of the manufacture of sugar, and of a bill lately introduced into Congress for the promotion of the sugar-beet industry. The former provides for a bounty of 1 cent per pound on sugar "from beets, sorghum, or other sugar-yielding canes or plants, grown in Nebraska, which contains at least 10 per cent of crystallized sugar."

In an appendix to the bulletin the co operation of all persons in the State who are interested in the sugar-beet industry is solicited. The station will distribute seed to a limited extent, and analyze beets sent with definite answers to its circular of inquiry.

Nebraska Station, Bulletin No. 14, June 7, 1890 (pp. 149).

INSECTS INJURIOUS TO YOUNG TREES ON TREE CLAIMS, L. BRUNER, (illustrated).—This is a report on "some of the most injurious insect enemies of young trees, such as are grown on tree claims, homesteads, and farms, for wind breaks and fuel, in Nebraska." Such insects as destroy the foliage rather than the wood and roots of trees are described in the main portion of the bulletin and a few species of "defoliaters" in an appendix.

"Considerable space has been devoted to each of the species treated, while the text is made clearer by the addition of many explanatory illustrations of both the injurious species, and their insect enemies that assist us in keeping them in check. In addition to a general introductory chapter on the causes for the increase and spread of these injurious insects, together with modes of prevention, remedies have been suggested in each case after the life history of one of them has been given." The appendix also contains a short article on insecticides and how to apply them. The author expressly disclaims originality for his descriptions and most of his illustrations, and states that the bulletin is a compilation from many sources, proper credit being given to each authority in the body of the work. There are, however, many incidental references to observations by the author. The list of insects described includes the Cecropia silk-worm (*Platysamia cecropia*, Linn.), with its enemies, *Ophion macrurum*, *Cryptus nuncius*, *Chalcis mariæ*, and a Tachina fly; Polyphemus silk-worm (*Telea polyphemus*); apple-tree tent-caterpillar (*Clisiocampa americana*, Harr.), with its enemies, *Pimpla annulipes*, *Pimpla conquisitor*, *Calosoma calidum*, *C. scrutator*, *Podisus spinosus*, and *Perillus claudus;* forest-tree tent-caterpillar (*Clisiocampa sylvatica*, Harr.), with its enemy, *Pimpla pedalis;* fall web-worm

(*Hyphantria cunea*), with its enemies, *Podisus spinosus*, *Telenomus bifidus*, *Trichogramma* sp. (?), *Meteorus hyphantriæ*, *Apanteles hyphantriæ*, *Limneria pallipes;* walnut caterpillar (*Datana angusii*, G. and R.); green-striped maple-worm (*Anisota rubicundo*, Fab.), with its enemies *Tachina anonyma*, *T. bifasciata* and *Limneria fugitiva;* cotton-wood dagger-moth (*Acronycta lepusculina*, Gn.); maple tree dagger-moth (*Acronycta americana*, Harr.), with its enemy *Rhogas intermedius;* smeared acronycta (*Acronycta oblinita*, Sm. and Abb.), with its enemies, *Ichneumon unifasciatatorius*, *Aleiodes rileyi*, and *Polysphincta* sp. (?); ash saw-fly (*Monophadnus bardus*, Say), with its enemies, *Metapodius femoratus* and *Podisus spinosus*; large willow saw-fly (*Cimbex americana*, Leach); yellow-spotted willow-slug (*Nematus ventralis*, Say); sycamore leaf-beetle (*Chlamys plicata*, Fab.); cotton-wood leaf-beetle (*Lina scripta*, Fab.), with its enemies, *Coccinella 9-notata*, *Hippodamia convergens*, *H. 13-punctata*, *Megilla maculata*, *Harpalus pennsylvanicus*, *H. caliginosus*, *Pasimachus elongatus*, *Cicindela 6-guttata*, *C. limbata*, *Perillus claudus*, and *Podisus spinosus;* spotted cotton-wood beetle (*Lina lapponica*, Linn.); willow lina (*Lina* sp. (?)); large yellow and black swallow-tail butterfly (*Papilio turnus*, Linn.), with its enemies, *Trichogramma minutum*, *Trogus exesorius*, *Copidosoma turni*, and *Masicera frenchii ;* antiopa or yellow-bordered purple butterfly (*Vanessa antiopa*, Linn.), with its enemies, *Ichneumon fossorius*, *Haplismenus terrificus*, *H. morulus*, *Pteromalus vanessæ*, *P. puparum*, *Derostenus antiopæ*, *Telenomus graptæ*, *Phorocera concinnata*, and *P. edwardsii;* sphingids or hawk-moths, with their enemy, *Apanteles congregatus;* eglanterina moth (*Pseudohaiza eglanterina*, Boisd.).

New York Cornell Station, Bulletin No. 16, March, 1890 (pp. 15).

GROWING CORN FOR FODDER AND SILAGE, I. P. ROBERTS, M. AGR., AND H. H. WING, B. AGR.

Test of varieties of silage corn (pp. 3–9).—Forty-one varieties, including Kaffir corn, were tested in 1889, fifteen on one-tenth-acre plats to compare yield and composition, and twenty-six in single rows to compare composition without regard to yield. Those in the single rows were planted May 8, and those in the plats May 14. Sibley's Pride of the North was planted on duplicate plats, one plat with purchased seed, and one row with seed grown at the station for several years and well acclimated. Cutting was delayed as long as possible, but on September 18 an average hill of three stalks of each variety was selected, the stalks were dried, and a sample was taken for analysis. At the time of cutting, four varieties, Compton's Early, King Phillip, Self-Husking, and Suffern's Monarch Pop, all planted May 8, had passed the best state for ensiling; twelve were in the best condition for cutting, *i. e.* well glazed but with stalks still green. These were Chester County Mammoth, Golden Dewdrop, King of the Earlies, Longfellow, N. B. & G.

Yellow Dent, Pride of the North (C. U. seed), White Dent, White Flint, Yellow Cleavage, Yellow Flint, planted May 8; and Pride of the North (Sibley seed), and Sanford, planted May 14.

The remainder, with the exception of the Brazilian Flour corn, which was very immature, were in various stages of the roasting-ear condition. None were mature enough for best results, though a few approached this condition, and perhaps in a warmer and dryer season would have become mature. The results of analysis of all the varieties tested are given in a table. "With a few notable exceptions the variations in the percentage of water constitutes the main difference in composition." The table quoted herewith gives the average composition of the different classes of corn included in the varieties tested.

Composition of corn of the different classes.

	No. of varieties	Water.	Dry matter	Protein	Fat.	Nitrogen free extract.	Fiber.	Ash	Nutritive ratio.
		Per ct	*Per ct*	*Per ct.*	*Per ct*	*Per ct*	*Per ct*	*Per ct.*	
Dent	25	75 62	24 38	1.72	.60	14 27	6.57	1.22	1· 12.8
Flint	7	73 25	26.75	2 15	82	15.42	6 66	1.70	1 11.7
Sweet	6	81.16	18 84	1.50	53	11.18	4.59	1.04	1. 11.4
Pop	1	78 93	21.07	1.07	44	10 21	7 50	1 25	1 11 3
Soft	1	82 56	17 44	1 13	.30	9 27	5.87	87	1: 14 1
Kaffir	1	76 05	23.95	2.34	.41	11.40	8.36	1.44	1 8 9

It will be recalled that the analyses were made of the whole plant as harvested and that the specimens were in different stages of development, "barely in milk," "in milk," "roasting-ear," and "mature." In computing the nutritive ratio "the whole of the nutrients instead of merely the digestible portions, are compared."

From this it appears that "of the three classes, dent, flint, and sweet, the flints have the largest percentage of dry matter and the sweets the smallest; the sweets have a slightly higher ratio of protein. The dents have somewhat more water than the flints and considerably less protein, but in general they give a much larger amount per acre both of green forage and dry matter." The specimen of Kaffir corn, with a moderate amount of water, has a much higher proportion of protein than the average of the specimens of any of the three classes mentioned. "It did not, however, make a large growth of green fodder. All things considered, it seems to us that that variety of dent corn which will approach fairly well toward maturity in ordinary seasons in the locality is the best for silage purposes." A third table gives the estimated yield in pounds per acre of the green forage, the dry matter, and the several nutritive constituents of all the varieties planted in tenth-acre plats. Omitting two cases in which the seed was inferior, the yield of green forage ranged from 12.8 to 22.1 tons, and that of dry matter from 2.4 to 4.1 tons, the proportions of dry matter varying from 17.4 per cent in a sample "in the milk" to 30.2 per cent in a "mature"

sample. "It will be seen that there is no relation between the amount of green forage and the amount of dry matter. Though the very immature Brazilian flour corn from its immense growth did produce the greatest amount of dry matter, there were four varieties that produced more protein and six varieties that produced more fat." The yield of the various constituents is also given for a measured acre of Pride of the North corn grown in a corn-field which had been well manured. The yield of green forage 30,108, pounds, dry matter 9,109 pounds, and nutritive ingredients from this acre was in general about twice as great as that calculated for the same area from the product of the same variety on a one-tenth-acre plat from seed obtained from seedsmen. Some of this difference may have been due to differences in soil and manuring, but in the language of the writer: "It seems to us that most of the difference must be due to selection and acclimation of the seed [at the station] during several years."

The yields per acre of water and nutritive ingredients are illustrated by two diagrams, one in black, representing the water; and the other in colors, representing the various other constituents.

Best period for cutting (pp. 10–15).—"As the result of analyses made at different periods of growth in 1888 we strongly urged (See Cornell Station Bulletin No. 4, p. 52) that only such varieties of corn should be grown for silage as would reach a good degree of maturity in the locality grown. These conclusions have been abundantly confirmed, not only by our own experiments, repeated in 1889, but by similar experiments at several other stations."

The variety used in 1889 was the same as in 1888, viz., Pride of the North, from seed grown at the station during several years. The soil was a clayey loam. The corn was planted about May 12 in hills 3¼ by 3⅜ feet apart, and received ordinary cultivation. The season was late and very wet. The first cutting was made August 2 when the corn was just coming into blossom; the second August 17, when the kernels were just beginning to fill with milk; the third and fourth, August 31 and September 10, when the corn was in the "roasting-ear" condition; and the final cutting September 24, when the corn was perhaps a trifle more mature than it was in 1888 on September 3. At each cutting three average hills were selected and cut close to the ground. They were then treated in the same manner as the samples of the different varieties already described. A table shows the percentage composition at the various periods. It is noticeable "that the most marked difference is in the great increase in dry substance between September 10 and September 24, and that there was more water on August 17 than on August 2. This is entirely out of the usual experience, and may perhaps be due to the individuality of the plants sampled. In regard to the dry substance we find, as is usual, that the per cent of protein gradually diminishes and that of the carbohydrates and fiber increases as development approaches maturity. * * * At each period of cut-

ting, except the last, besides taking the sample, there were cut and weighed sixty hills of corn. The weight of the corn so cut was used as a basis for computing the yield of green fodder and of the various constituents per acre, except in the cutting of September 24, when a measured acre was cut and weighed. The results are shown in another table. * * * It will be seen that between the first and last cutting the dry matter and carbohydrates increased about 150 per cent, the fat about 125 per cent, and the protein nearly doubled. In our experiments last year we found that the total feeding value, in the period between tasseling and ripening, increased 166 per cent, so that the experiments of this year confirm those of last." Similar experiments at the stations in New Hampshire (See New Hampshire Station Bulletin No. 3), Pennsylvania (See Pennsylvania Station Bulletin No. 7), and at Geneva, N. Y. (See New York State Station, Eighth Annual Report, p. 86), are briefly cited, and the following table of comparative results is compiled:

Increase in percentages of nutritive ingredients of corn in maturing.

Year	Place.	Variety.	Stage of maturity: First cutting.	Stage of maturity: Last cutting.	Date: First cutting.	Date: Last cutting.	Gains between first and last cutting: Dry matter.	Albuminoids.	Fat.	Carbohydrates.
							P. ct.	P. ct	P ct	P. ct
1889	Cornell Agricultural Experiment Station.	Pride of the North.	Bloom ...	Mature ..	Aug. 2	Sept. 24	150	90	129	169
1888	.. do	. do	Bloom ..	Nearly mature.	July 24	Sept. 3	217	134	374	300
1889	New York Agricultural Experiment Station.	King Philip	Tasseled	Ripe . ..	July 30	Sept. 23	389	183	335	462
1887	New Hampshire Agricultural Experiment Station.	Average four varieties.	Tasseled*	Glazed* ..	Aug. 5	Sept. 16	112	50	84	130
1888	Pennsylvania Agricultural Experiment Station.	Average ten varieties.	Tasseled†	Ripe and cured.†	.... ..	....	155	.....	.....	....
Average of all trials							205	114	230	265

* The average condition of the four, as near as may be.
† The actual condition of each, dates not given.

The results of all these experiments unite to show that there is a large increase of all the classes of nutrients as the corn proceeds from tasseling to ripeness.

The bulletin concludes with a summary based on these and other experiments at this station and elsewhere, from which the following points are taken:

(1) In growing corn for silage care should be taken to select the largest variety that will fully mature before frost in the locality where grown.

(2) Heretofore it has been a common practice to sow or plant corn for fodder and ensiling entirely too thick. Starch and sugar are not fully developed without an abundance of sunlight.

(3) Immature plants are likely to contain a very large per cent of water. It will readily be seen that 25 tons of green corn containing 90 per cent of water, gives but 5,000 pounds of dry matter; while 12 tons containing 75 per cent of water gives 6,000 pounds of dry matter. In the latter case we get a thousand pounds more dry matter, and have to handle and store less than half the weight of gross material; while the corn will still have sufficient moisture to give the resulting silage that succulence upon which its value for feeding, as compared with dry forage, largely depends.

(4) While the percentage of nitrogen grows less as the plant approaches maturity, a much larger proportion of the nitrogen in the unripe material is in the less valuable form of amides, than in the mature plant. So that the less percentage of nitrogen in the riper product is compensated for in its increased nutritive value.

(5) So far all the experiments go to show that the effort should be made to raise the largest yield of grain irrespective of stalks, no matter what purpose it is intended for. If one variety gives an equal yield of grain and a greater amount of stalks and blades, then of course it should be preferred, for fodder and silage purposes, to the variety that gives the less stalk and blade; but it will be found that as a rule the larger the yield of grain, the larger will be the yield of stover.

(6) Finally, the fact should not be lost sight of, that wood and water alone are not good foods for animals, and that they are expensive products to handle.

New York Cornell Station, Bulletin No. 17, May, 1890 (pp. 10).

A DESCRIPTION OF COCHRAN'S METHOD FOR THE DETERMINATION OF FAT IN MILK, FOR THE USE OF DAIRYMEN, G. C. CALDWELL, PH. D. (pp. 19–25).—This is a brief, popular explanation of the apparatus and of the manner of using it, with accounts of the tests of this and other methods.

"Several methods for the determination of fat in milk, of such a character that they can be carried out without special acquaintance with chemical manipulation, have been described recently in experiment station bulletins and chemical journals.* All of them depend upon the same general principle—a partial decomposition or solution of some of the constituents of the milk by heating it with acid or alkali, and in most cases taking up the separated fat by ether or gasoline; in one method (Patrick's) no ether or gasoline is used, and in so far this method has the advantage over all others."

Tests of these methods were made in the laboratory by Messrs. W. P. Cutter, of the station, and Mr. N. E. Wilson, of the university. The methods of Short, Cochran, and Parsons were tested by means of fifteen specimens of milk; that of Failyer and Willard with twelve of the same specimens; and those of Patrick and Cochran were compared with four specimens. Gravimetric determinations were made in each specimen by Babcock's asbestos method.†

All the determinations were made in duplicate and some were repeated three or four times, the results being, in most cases, identical.

* F. G. Short, Wisconsin Station, Report for 1888. G. E. Patrick, Iowa Station, Bulletins 8 and 9. C. L. Parsons, [New Hampshire Station, Report for 1888, p. 69], Journal of Analytical Chemistry, III, 273. Failyer and Willard, *Ibid.*, 295. C. B. Cochran, *Ibid.*, 381.

† New York State Station, Report for 1883, pp. 166 and 169.

In the case of the four samples of milk tested by the methods of Patrick and Cochran, the averages for the two methods did not differ in any case by more than 0.06 per cent. from each other, nor by more than 0.09 per cent from those obtained by the gravimetric method. With the eleven samples tested by the four methods named and by the gravimetric the variations were in several cases considerably wider, but, on the whole, the results by the different methods agreed very closely.

"The particular object of these tests was to determine which of these methods could be specially recommended to the dairymen of this State, for accuracy, simplicity of the apparatus, and ease of manipulation. Since, as shown, they do not differ essentially in accuracy, the selection of the method to be recommended must be based on the two other points. All things considered, Cochran's method seems to be clearly preferable to the others in these two respects. A full working description of that method is therefore given, essentially as by the author himself in the original article, although in some parts with much more fullness in detail, so that with proper care in following directions no one need go amiss."

Briefly described the method consists in boiling the milk with sulphuric and acetic acids in a 100 cubic centimeter Erlenmeyer flask, cooling, adding ether, and boiling again until the fat has gathered at the surface and the ether volatilized. The contents of the flask are then transferred to a "fat measure." This is a flask with the neck narrowed and elongated into a graduated measuring tube, and provided with a side tube by which the contents of the boiling flask and hot water are introduced. By adding a proper quantity of water the fat, which rests upon the top of the diluted milk in the fat measure, is brought into the graduated neck and thus conveniently measured.

Mr. Cochran stated in his original article on this subject, that this method of determining fat in milk was then (1889) in use in upwards of fifty creameries, mostly in Southeastern Pennsylvania, and that with the largest and most improved form of apparatus for the heating of the samples, and after becoming perfectly familiar with the manipulation, sixty tests can be made in from two to three hours.

If scrupulous attention is paid to every detail of the manipulation, as here described, I think that any one who is not too clumsy fingered and is accustomed to nice, careful work, can get reliable results with the method after some practice, such as any method would require. But in any case a little training under the instruction of some one who is perfectly familiar with it would undoubtedly be profitable.

With any such who can spend a week at Ithaca, arrangements will be made, by special correspondence, for such instruction in the laboratory of the experiment station.

Ohio Station, Bulletin Vol. III, No. 2, February, 1890 (pp. 58).

Commercial fertilizers, C. E. Thorne (pp. 17–73).—"Chemical or commercial fertilizers were almost unknown in Ohio a dozen years ago, outside of a few counties in the extreme eastern and northeastern parts of the State. Statistics collected during recent years, however,

indicate that the use of these fertilizers is steadily increasing, and that the farmers of the State are now spending not less than $1,000,000 annually in their purchase." The object of the experiments described in this bulletin, which are in continuation of work begun by the station in 1882, and described in a previous report, is to get light upon the economy of the use of artificial fertilizers in Ohio. Some of the experiments are repetitions of those described in previous reports, the same fertilizers being applied to the same plats year after year. Others were begun this season (1889). The geological characteristics and previous treatments of the soils are described in more or less detail.

Field experiments with fertilizers on corn.—Experiments on the station farm (pp. 27–30).—The soil being of great natural fertility, the object of the experiment became practically to find (1) how to maintain economically the fertility of the soil, and (2) the limit to which the fertility of such a soil may be profitably increased.

Five sections of ground on the station farm were laid out and subdivided into plats of one tenth and one twentieth of an acre each. Four of these sections were devoted to continuous cropping with corn, oats, wheat, and potatoes, respectively, and one to rotation cropping. The plats were separated by alley-ways 2 feet wide; and a tile drain laid under every alternate alley-way gave to each plat a drain on one side or the other. Every third plat was left unmanured, and all the plats were plowed into low ridges, leaving furrows in the alley-ways to keep fertilizers from affecting adjoining plats, and to prevent water from standing on the land under experiment.

Superphosphate at the rate of 320 pounds, muriate of potash 160 pounds, and nitrate of soda 160 pounds per acre were applied singly (Nos. 1, 2, and 3), two by two (Nos. 4 to 6), and all three together in a "complete" fertilizer (No. 7), thus making a "soil test." The effects of varying quantities of nitrogen were tested in Nos. 8 and 9, which differed from No. 7 in that twice and three times the quantities of nitrate were used. In No. 10 the 160 pounds of nitrate of soda of No. 7 were replaced by 120 pounds of sulphate of ammonia. The plans were essentially similar to those of the soil tests and special nitrogen experiments described in Circular No. 7, of this Office, except that the nitrogen tests were less detailed. To test the action of phosphoric acid in other forms of combination the superphosphate of No. 7 was replaced by 300 pounds of South Carolina rock in No. 11 and by 400 pounds of Thomas slag in No. 12. One plat received farm manure, 8 tons, and another linseed-oil meal, 1,800 pounds per acre. The series includes twenty-two plats, eight of which were not manured. The results for 1888 were previously reported. Those for 1889 are here given in tables, which show the quantity and cost per acre of the fertilizers used, the yield of corn per acre as weighed when harvested in November, the per cent of loss of grain in drying until January as determined by drying 100-pound samples, the estimated yield of dried corn (January weights), and the

apparent increase due to the fertilizers. The richness of the soil is shown in the fact that the unfertilized plats averaged 58.3 bushels of dried corn.

"In computing the increase of the fertilized plats each fertilized plat is compared with the unfertilized plats between which it lies. * * *

"A careful study of these tables fails to discover that any marked influence has been exerted on the crop by any of the fertilizers. There are considerable variations, it is true, between the yields of some of the fertilized plats and the unfertilized one adjoining; but these variations do not occur with sufficient regularity to justify the assumption that they are due to the fertilizers. Even where it seems safest to assume that the fertilizers have increased the crop, the increase shown is wholly inadequate to cover the cost of the manure or fertilizer. * * *

"In regard to this use of oil meal as a fertilizer it may be well to explain that the object in view is to determine its incidental value as a fertilizer. Linseed-oil meal is a valuable feeding stuff, and careful experiments have shown that after it has performed its function as a feeding stuff, two thirds of its value as a fertilizer may yet be recovered in the manure, if the manure be properly cared for. But we are shipping our oil meal to Europe, and sending to South America for nitrate of soda, to Germany for potash salts, and to South Carolina for phosphatic rock with which to compound our fertilizers."

Co-operative field experiments with corn.—Soil tests (pp. 30–47).—These were conducted by farmers in seven counties of the State. Fertilizers were used as in soil tests Nos. 1 to 7 above described, no comparison being attempted between different quantities or kinds of nitrogen and phosphoric acid. Tables show the results of each test, and a summary of the average increase of corn on the fertilized plats. In five tests the evidence is conclusive that the fertilizers had a marked effect upon the crop. In general the results were most marked on poor or worn-out soils. With corn at 33⅓ cents per bushel, however, superphosphate was used with profit in only three of the cases, muriate of potash in only one case, and nitrate of soda failed in every case to return its cost whether used alone or in combination with other fertilizers.

One of these farm tests was made by Mr. G. H. Bunnell, of Jefferson, Ashtabula County. "The land had been in pasture about thirty-five years, then cultivated about twenty years in a regular rotation of corn, oats, wheat, and grass, the grass occupying the land until it required reseeding. In this entire period it had had but one application of manure. In this experiment we get a very striking result. The average yield of the unfertilized plats is 31.9 bushels per acre, and that of the four plats receiving phosphoric acid is 48.8 bushels—an increase of nearly 17 bushels. It would seem, moreover, that this increase is due entirely to the phosphoric acid or to the combination of phosphoric acid with potash, and that nitrogen is not needed. But, as has been already pointed out, it is not safe to draw final conclusions from a single test."

In an experiment by Mr. B. E. Furnas, in Miami County, on a "sugar-tree clay, with subsoil of gray clay and gravel," which had been in cultivation eighty years, all the fertilizing elements seem to have increased the crop, whether used singly or in combination. The details are given in a table. "The average yield of the unfertilized plats was, avoiding fractions, 43 bushels per acre; that of the plats receiving a single fertilizing element, 50 bushels; that of the plats receiving two elements, 60 bushels, and that of the one receiving the three, 73 bushels—an increase of 7, 17, and 30 bushels, respectively. But even with this large increase, the complete fertilizer has failed to pay its cost, with corn at 33⅓ cents a bushel, while the partial fertilizers have been used with still greater loss."

The results of the Ashtabula County and Huron County tests are strikingly uniform. These tests are located nearly 100 miles apart, but both agree in showing that on those soils and for this season phosphoric acid was the essential element in a fertilizer for corn, with potash next in importance, while nitrogen was not needed at all. * * *

In the Butler County test, located in the opposite corner of the State from the one in Ashtabula, and nearly 250 miles to the southwest, nitrogen seems to be as little required for the development of the corn plant as in the more northerly region; but in this test potash seems to play the leading part, with phosphoric acid second in importance.

Holmes and Miami Counties lie in the middle belt of the State, but about 100 miles apart. In the test in these counties we have again a series of as striking coincidences in the results as those found in the Ashtabula and Huron County tests; but here nitrogen appears to have been equally efficacious with phosphoric acid in increasing the yield, whether used alone or in combination, and potash has held about the same rank as in the northern counties.

Conclusions.—In the author's opinion the following conclusions, though based on the experiments of one or two seasons, are more likely to be confirmed than reversed by future experience.

(1) On soils capable of producing 50 bushels of shelled corn per acre with good drainage and tillage, no artificial fertilizer or combination of such fertilizers is likely to produce sufficient increase of crop to pay the cost of the fertilizer in the crop to which it is applied, at present prices of corn and fertilizing materials.

(2) On soils that are decidedly deficient in natural fertility, phosphoric acid may sometimes be used with profit as a fertilizer for corn, and potash and nitrogen may be so used in rare instances, and this whether these substances be used separately or in combination.

Field experiments with fertilizers on oats (pp. 48, 49).—The arrangement of plats and application of fertilizers were the same as in the preceding experiments. The benefits of nitrogen were well marked throughout the season, but were lost by the lodging of the grain. "The problem of securing larger crops of oats is rendered doubly complex by the tendency of this plant to lodge when well fed."

Field experiments with fertilizers on wheat (pp. 49–56).—A plat experiment conducted at the station on the plan previously described

showed results "almost wholly negative," the field apparently containing all the fertilizing elements necessary for a full crop. The unfertilized plats yielded from 36.7 to 50.5 bushels of grain per acre. The yield with stable manure was only 33.1 bushels.

Of two co operative farm tests with wheat, one was vitiated by rust, which practically destroyed the crop, the other served to indicate that nitrate of soda and superphosphate were of some benefit. In both cases nitrate was applied in the fall, "probably a mistake," as careful investigators believe its liability to be washed away will be lessened by delaying the application till April or even May.

At the request of the station a few farmers in different parts of the State made the experiment of applying in the spring of 1889 a small amount of nitrate of soda to wheat, to which bone meal or a similar phosphatic fertilizer had been applied in the fall, the object being to find whether nitrate may be used profitably as a fertilizer on wheat which has received a fall dressing of fertilizer rich in phosphoric acid and poor in nitrogen. The plan was to leave one or two strips without fertilizer in the fall, apply barn-yard manure to one strip and bone meal to two, one of which latter should have in addition an application of nitrate of soda and muriate of potash in the spring at the rate of 160 pounds each per acre. In three tests in which the plan was fully carried out, there was a decided increase of crop from the spring application of nitrate and potash. Directions are given for conducting the experiments on a somewhat different plan, so as to determine the proportion of the two substances needed by the plant.

Experiments on plants grown in boxes (pp. 56–62).—Inequalities of soil constitute a serious difficulty in field experiments. One means of meeting this difficulty is by trials on a small scale, in boxes or otherwise.

Whoever has carefully looked over the tables given in the bulletin must be struck with the great diversity in natural productiveness of soils selected because of their apparent uniformity, as shown by the differences in yield of the unfertilized plats. These differences, however, are not exceptional, but are quite within the limits of variation which practical field experimenters have learned to expect in such work.

By systematic and continuous cultivation of a series of plats, under uniform treatment, such inequalities as have arisen from temporary causes will gradually disappear, and in the course of years such results may be arrived at as those shown in the experiments of Messrs. Lawes and Gilbert at Rothamsted, England, where it is evident that all minor inequalities in natural fertility have been obliterated in the grand aggregate results of a half century of persistent work.

But we can not afford to wait half a century for results. *Something must be definitely indicated from year to year, if field experimentation is to hold a permanent place as a practicable method of research.*

By repeating the same experiment on various soils, after some such method as that explained on previous pages of this bulletin, some of the errors indicated may be in a measure corrected. But this method also leaves much to be desired. It does not remove the source of error, but is only useful because the inequalities of one soil are likely to be offset by different inequalities in another soil, and thus one error is made to counteract another.

The only method by which a soil of absolute uniformity can be secured is to deal

with a quantity so small that it may be thoroughly mixed, after which experiments upon it may be conducted in pots or boxes, or in plats of very small size in the field, made by removing the surface soil to a uniform depth, mixing it thoroughly, and returning it to the original situation.

The objections to this method of experiment are, that it involves the placing of the soil under abnormal conditions as to heat and drainage, if boxes or pots are used, and the dealing with such a limited number of plants in any case that the idiosyncrasies of individual plants, or the errors liable to arise from calculating acre yields from yields of single plants, or small numbers of plants, are liable to be very misleading. As one of several co-ordinate methods of investigation, however, in which the results of one method are used to verify those of another, the culture of plants in pots or boxes must hold an important place.

In the spring of 1888 two series of boxes, each 18 inches square by 12 inches deep, were filled, one series with clean sand from the beach of Lake Erie, the other with mixed soil from the station's experimental field, and planted with selected grains of corn. Uniform drainage was secured for the boxes, and around them corn of the same variety was planted in the open ground to insure fertilization of the ears. At planting time and at intervals afterward dissolved bone-black, muriate of potash, and nitrate of soda were applied to the soil of the different boxes, singly and in various combinations, and also barn-yard manure and linseed-oil meal. The plan followed in the use of fertilizers and also the appearance of the plants at maturity are illustrated pictorially by plates. The plants grown in sand reached proximate maturity only in those boxes which received nitrate and superphosphate, or nitrate, superphosphate, and potash. In the other series all plants grew to about the same height and produced grain in the proportion in which nitrogen had been added. In the following fall (1888) wheat was sown in these boxes and fertilizers applied as before. The results, also shown in plates, serve to demonstrate "the futility of using for wheat a fertilizer containing no nitrogen, as well as the inadequacy of nitrogen when not aided by phosphoric acid." Similar experiments were conducted in 1889 with German millet, with like results, except that barnyard manure showed a marked superiority. To encourage this method of investigation among farmers the station offers to furnish free the necessary fertilizers, with instruction for their use.

We have two objects in view in illustrating these box experiments: the first is to add their testimony to that of the field experiments previously described, and the second is to suggest to farmers a very simple method of ascertaining the needs of their soils; a method within the reach of every farmer or farmer's boy; one more reliable than the most elaborate chemical analysis; more reliable, even, than an actual field test, under ordinary circumstances.

To make this test, simple pine boxes will be found most convenient. We have found the size mentioned, namely, 18 inches square by 12 inches deep, to be well suited for the small grains; for corn, however, we recommend field experiments, as it is not practicable to use boxes large enough to give proper root space to more than one or two plants, and there is such a great difference in the individuality of different plants of corn that experiments on single plants are liable to be misleading.

Believing that valuable suggestions respecting the needs of various soils may be

obtained through this method of investigation, the station makes the following proposition:

To any farmer who will undertake to carry out carefully on oats or wheat such a series of box tests as that illustrated in plates I to III, and to send the crops produced to the station for final determinations, the station will furnish free the fertilizers necessary for the experiment, with instructions for carrying out all its details.

Acknowledgments are made to Mr. J. Fremont Hickman, station agriculturist, for valuable assistance in supervising these experiments, and to J. A. Alwood, farm foreman.

General conclusions.—These experiments seem to justify the conclusions [which apply to the soils used in these experiments] that—

(1) "In fertilizing for wheat a much greater crop may be produced by using phosphoric acid and nitrogen in approximately equal quantities, the phosphoric acid being applied in the fall, the nitrogen (if used as nitrate) chiefly in the spring, than by the ordinary practice of using phosphates only.

(2) "That nitrogen may often, but not always, be omitted from a fertilizer for corn without detriment to the crop.

(3) "That in very many, if not the majority of cases, neither wheat nor corn will return sufficient increase of crop to cover the cost of any artificial fertilizer, at present prices of grain and fertilizers respectively."

It is believed, however, that the grass or clover following the wheat is much improved by the fertilizers, but whether the loss resulting in the wheat crop is thus compensated for is a question for solution by systematic experiment.

Analyses and valuation of fertilizers (pp. 64–73).—These include tabulated analyses by Prof. N. W. Lord, chemist of the Ohio State Board of Agriculture, and valuations, by the secretary of the board, of two hundred brands of superphosphates and acidulated fertilizers; and forty-seven brands of bone and "untreated" organic matter.

Pennsylvania Station, Bulletin No. 11, April, 1890 (pp. 16).

INDIAN CORN AS A GRAIN AND FODDER CROP, W. H. CALDWELL, B. S.—In Pennsylvania, according to the census of 1880 for the corn crop, the money value of the ear corn exceeded, and that of the ear corn and stover was double that of the wheat crop. Corn is important in rotation, is a profitable hoed, cultivated, or restorative crop; helps to keep land free from weeds and to maintain fertility, and particularly to improve the mechanical condition of the soil. To the feeder of animals this crop has a threefold value. The corn meal is fed to beef and dairy cattle; the stover is more prized as land is more largely cultivated and Western competition grows sharper, making cheapened products necessary; and the silage of this crop forms a succulent and nutritive fodder for winter, which is appetizing for the animals and cheaper to grow than roots.

An experiment was carried on at this station in 1888, to study the

adaptability of some varieties of field corn to this section, and also to make observations upon the yield of the corn plant at different stages of its growth.* The work was repeated in 1889, especially in the latter direction, the object being to test both the total yields and the amounts of food material (dry matter). In some cases the amounts of nutritive material in the different parts of the corn plant at different stages of growth were determined.

The following varieties were tested: *Silage varieties.*—Burrill & Whitman Ensilage, Breck's Boston Market Ensilage, Blount's Prolific, Salzer's Fodder or Ensilage, White Southern. *Planted for late forage.*—Red Cob Ensilage, Southern Fodder, Stowell's Evergreen. *Flints.*—Angel of Midnight, Longfellow, Pipe Stem or Top-Over, Self-husking. *Dents.*—Champion White Pearl, Cleaver, Golden Beauty, Golden Dent, Hickory King, Leaming, Piasa Queen, Queen of the North, Queen of the Prairie, Wisconsin Earliest White Dent.

Silage Varieties.—Four rows (length not stated) of each variety were cut at the time of filling the silos, September 18. "It was the intention to cut them when the kernels began to glaze, but the corn had not reached that stage, and would not before frost. The kernels of the ears in the rows cut were beginning to fill out." The product of two of the four rows was weighed and the proportions of dry matter determined; that of the other two was carefully shocked and field cured, and determinations were then made of total weights and proportions of dry matter in ears and stover. The largest yield (of corn cut for silage) was with the White Southern, which gave nearly $27\frac{1}{2}$ tons of green crop and nearly 12 tons of dry matter per acre. The Burrill & Whitman gave $31\frac{1}{2}$ tons of green material and $5\frac{1}{2}$ of dry matter. Breck's Boston Market gave a little less. The smallest yield was with the Salzer's Fodder, which gave 24 tons of green crop and only $2\frac{1}{2}$ of dry matter. The average of the five varieties was $26\frac{3}{4}$ tons of green crop and 6 tons of dry matter.

Varieties planted for late forage.—These were cut when very immature. They ranged from 8.9 tons to 4.9 tons of green crop and from $1\frac{1}{5}$ tons to $\frac{3}{5}$ of a ton of dry (water-free) matter, Southern Fodder and Red Cob Ensilage giving nearly twice as much as the Stowell's Evergreen.

Flints and Dents.—The germinative power of the seed, relative earliness of development and maturity of plants, distribution of food material (dry matter) in the different parts of the plant, gain of dry matter in maturing, and yields per acre were observed. Comparisons were made of the germinating power of the seed in germinators and in the field (See Bulletin No. 8 of the Station, and Experiment Station Record, Vol. I, p. 295). "The germinative power was ascertained in the germinators by Mr. Butz, the horticulturist of the station. As soon as the plants had appeared above ground, and before cultivation, they were counted, and the per cent which vegetated found. Although the

* Pennsylvania Station, Report for 1888, p. 26, and Bulletin No. 7; and Experiment Station Record, Vol. I, p. 143.

per cent which vegetated was lower than that which sprouted in the germinators, the results agree in general. The varieties showing the greatest germinative power in the laboratory vegetated best in the field. The results show that farmers can safely guide themselves in the purchasing of seed corn by the results of germination tests. The lower results in the field are explained by the horticulturist by the fact that some seeds will germinate but have not strength enough to vegetate.

The experiments were made on land which had received barn-yard manure at the rate of 15 tons per acre. Each variety was planted on a plat of one twentieth of an acre in four rows. Two alternate rows of each variety were cut when the kernels began to glaze. The weight and height were taken, together with samples for determination of moisture. The other two rows were cut when matured, weighed, and allowed to field cure. When cured the total weight was taken and the plants divided into four parts, namely, ears, husks and leaves, lower half of stalks or butts, and upper part of stalks or tops. The weight of each of the separated parts was ascertained and a sample of each taken for determination of moisture.

The results are stated in tables which give the dates of "first tassel," "first silk," "ears beginning to fill out," and "kernels beginning to glaze"; yields per acre of crop as harvested and of dry (water-free) matter at the two periods of harvesting, with separate figures for the ears and stover and for their several parts, corn (kernels), cob, leaves and husks, butts, and tops.

"The Self-Husking variety was the earliest of the flints. The Queen of the North, Wisconsin Earliest White Dent, Minnesota King, Leaming, Queen of the Prairie, and Cleaver, were the dents which matured. They are named in the order in which they matured. The Golden Beauty, Golden Dent, Hickory King, and Champion White Pearl can not be recommended for cultivation for grain in our section. In the southern part of the State or in many of the river valleys they may be grown. They are named in order of earliness, although there is but slight difference between them. They would be much earlier than the larger varieties, Chester County Mammoth, Mammoth White Suprise, and White Giant Normandy, grown here in 1888."

As regards the distribution of dry matter (actual food matter) in different parts of the plants, the results obtained from the field-cured samples show that "fully half of the valuable dry matter is in the ears, and of this nearly one fifth is in the cob. The leaves and husks contain from one fourth to one third of the total, and there is four to five times as much of the remainder in the butts or harder and tougher parts, as in the tops. Thus, when fodder is fed whole, there is more or less waste of the butts by the animal. From our results it would seem that this loss would be from 7 to 22 pounds in every 100 pounds of dry matter. Practical experience proves that much of this may be saved by cutting up the cured fodder or putting it in the silo."

The table herewith, compiled from the more detailed figures of the bulletin, gives estimated yields per acre and increase of dry matter in maturing. The results are, of course, subject to the inevitable sources of error of plat experiments with different varieties of plants:

Name of variety.	Kernels beginning to glaze.			As cut for field curing.			Gain in dry matter (actual food material) by allowing crop to mature.
	Height.	Yield per acre.		Green weight.	Field cured.		
		Green material	Dry matter.		As weighed.	Dry matter.	
FLINTS.	Feet.	Pounds	Pounds	Pounds.	Pounds	Pounds.	Pounds.
Angel of Midnight	6.00	14,210	2,609	18,590	6,954	4,193	1,584
Longfellow	5.92	23,640	4,492	18,170	8,416	5,113	621
Pipe Stem or Top Over	5 59	17,920	2,937	18,550	8,640	5,822	2,885
Self-husking	5 25	17,460	3,581	11,680	6,149	3,994	413
Average of flints for 1889	....	....	3,404	.....	......	4,785	1,385
DENTS.							
Champion White Pearl	9 00	26,870	3,283	32,410	12,398	8,054	4,771
Cleaver	9 00	27,870	6,610	31,040	13,054	7,775	1,165
Golden Beauty	9 75	43,740	9,926	44,350	19,631	10,335	409
Golden Dent	10.17	42,580	10,140	40,820	19,100	8,971	1,169
Hickory King	9.50	39,760	10,020	45,790	19,604	9,830	190
Leaming	9 75	29,030	6,118	33,840	13,406	8,236	2,118
Piasa King	10.83	37,500	7,989	34,570	15,066	8,343	354
Queen of the North	6.50	17,390	5,987	16,430	8,063	5,647	-340
Queen of the Prairie*	10.00	24,390	5,530	35,170	14,030	9,137	3,607
Wisconsin Earliest White Dent	6 75	26,970	5,176	19,930	9,928	6,856	1,680
Average of dents for 1889	....	....	7,078	.....	....	8,318	1,240
Average of dents for 1888	....	....	5,259	.....	....	7,159	1,900
Average of dents for two seasons	....	....	6,168	.....	....	7,738	1,570

Experiments at this and other stations last season show that much of the dry matter of the corn crop is lost by harvesting before the corn is mature. These results are confirmed by the figures herewith given. At the time when the kernels began to glaze the largest amount of dry matter per acre in these trials was 5 tons, the smallest 1.3 and the average about 3 tons. In the field-cured material the maximum was 5.1; the minimum 2, and the average about 2.9 tons. The largest gain by allowing the crop to mature was $2\frac{2}{5}$ tons, the smallest 2, and the average three fourths of a ton. The average of the dent varieties for the two seasons shows a gain of nearly one fifth of the total amount by allowing the plants to mature; and the greatest gain, with one exception, was made by those varieties.

South Dakota Station, Bulletin No. 16, February, 1890 (pp. 8).

THE SUGAR-BEET, L. FOSTER, M. S. A., and J. H. SHEPARD, M. A.—"The station has completed its second season's tests of the sugar-beet, and the result gives us still better evidence of its crop value to South Dakota both for stock feeding and sugar making. While the crop was not as great either in per cent of sugar or yield of roots per acre as may reasonably be expected in more favorable seasons, or by following more

strictly the French and German methods of fertilizing and cultivating, it was still sufficiently large to insure a profitable crop even under the opposing influences of the past season."

The ground used for the experiment was in excellent condition, having received a heavy dressing of well-rotted manure last year. The varieties used were Imperial, Silesian, Redtop, Vilmorin, Lane's Improved, White Sugar, Salzer's Imperial, and Sweet White. The beets were planted by hand May 10, in most cases in rows 30 inches apart, the plants being thinned to 8 inches apart, but in some cases the rows were only 14 inches apart and the plants thinned to 6 inches apart. This thick planting yielded the smallest beets but they were uniformly the richest in sugar. Four average beets of Lane's Improved variety for each of three degrees of thickness of planting, and four average beets of each of the other varieties, forty specimens in all, were analyzed and the results reported in this bulletin. The yield per acre ranged from 14,840 to 32,500 pounds, and the per cent of sugar in the juice from 5.4 to 12.3, the smallest per cent of sugar being with the smallest yield of beets. "Again hope is expressed that farmers will raise small quantities of the sugar-beet. All samples delivered at the station laboratory will be analyzed free of charge."

Among the directions for beet culture drawn from general experience and given in the bulletin are the following:

(1) Thorough preparation of the soil is essential to success. The land should be plowed in the fall to an average depth of from 12 to 15 inches, but the final preparation should be made at the time of planting.

(2) Stable manure should be applied at the rate of not more than 15 tons per acre, since too much manure is apt to lessen the per cent of sugar by producing too weak and too prolonged growth.

(3) The largest yield per acre in sugar content and quantity of beets is obtained from the thickest planting. In Dakota the high price of labor practically limits the width of row to that which can be easily cultivated with implements drawn by horses, *i. e.* to from 20 to 24 inches.

(4) In the dry climate of Dakota the seeds should be covered fully 1½ inches to secure sufficient moisture for germination.

(5) Early cultivation kills weeds and forms a layer of mellow earth which acts as a mulch, keeping the soil below cool and moist.

(6) Thinning can be done best just after a rain.

(7) The crops should be stored in a root cellar or in piles in the field which are protected from freezing. The cellar should be cool and moist, and in the Dakotas it is found desirable to cover the beets with damp earth to keep them from wilting.

Value for stock feeding.—Beets and mangel-wurzels are, on the whole, the most reliable root-crops grown in the State.

South Dakota Station, Bulletin No. 17, March, 1890 (pp. 24).

SMALL GRAIN, L. FOSTER, M. S. A.—*Methods of seeding and quantity of seed.*—Under this head is given a preliminary report on a series of experiments begun in 1889 to compare drilling with broadcasting and to test different rates of seeding for wheat and oats. The results are regarded as "suggestive rather than conclusive."

Wheat.—Ten plats of an acre each of new bottom-land were sown with the variety known as Velvet Chaff or Blue Stem. They were divided into groups of two plats each. The several groups received seed at the rates of 4, 4½, 5, 6, and 8 pecks per acre respectively. Five plats out of each group were sown with a press drill and five with a broadcast seeder. Owing especially to differences of level and consequent differences in moisture the experimental area was not entirely uniform. "All through the season the grain on the press-drilled plats kept a few days in advance of the other. It came up first, was more evenly distributed, and made altogether the best stand. It began stooling earlier, and was also earlier and more even in heading out and ripening." The results, as stated in a table, were with 4 to 5 pecks of seed per acre, slightly larger yields on the drilled plats, and with 6 and 8 pecks slightly larger yields in favor of the broadcast plats. The average yield of the press-drilled plats was 25¼ bushels, while that of the broadcast plats was 24⅓ bushels.

Oats.—These experiments were on the same plan as those for the wheat. The soil was likewise bottom-land and not entirely uniform; it had been cropped for some years without manures. The variety was the Welcome, and the rates of seeding were 7, 8, 9, 10, 11, and 12 pecks per acre. The results are stated in a table. The yield per plat with 7 to 9 pecks of seed was somewhat larger on the drilled, and with 9 to 12 pecks was correspondingly larger on the broadcast plats. The average yield of drilled plats was 27¼ bushels, while that of the broadcast plats was 30⅛ bushels. On the broadcast plats the yield increased with the increase in the amount of seed used.

A recapitulation of the observations and results cites, as considerations in favor of the press drill, the quick germination insured by the seed being put at once into moist soil and the covering firmed; economy of seed and evenness of distribution, germination, and ripening; and the fact that strong winds lay bare a portion of the seed sown broadcast, while they rather deepen the covering of the press-drilled. With plenty of moisture at planting time broadcast seeding may serve as well as drilled; economy so far as cost of implements, labor, and horse-power are concerned, favors the broadcast method; in per cent of tillering the broadcast far exceeds the press-drilled.

Tests of varieties.—Tabulated notes of experiments (on plats of one eighth of an acre) on eleven varieties of winter wheat, sixteen of spring wheat, twenty-two of oats, and twenty-two of barley, with

descriptive notes on a few of the varieties. Drought and ground squirrels interfered with the yields.

Smuts.—This consists of extracts from the article by Dr. J. C. Arthur in Bulletin No. 28 of the Indiana Station (See Experiment Station Record, Vol. I, p. 207).

Virginia Station, Bulletin No. 5, March, 1890 (pp. 14).

NOTES ON FEEDING STUFFS, W. BOWMAN, PH. D.—This includes explanations of the technical terms used in statements of analyses of feeding stuffs, and a tabular record of analyses of corn meal, corn-and-cob meal, wheat bran, cotton-seed meal, and corn silage, made at the station.

Virginia Station, Bulletin No. 6, March, 1890 (pp. 20).

VARIETY TESTS WITH POTATOES, W. B. ALWOOD AND R. H. PRICE.—The importance of potato culture in Virginia is illustrated by the citation of statistics for the six principal crops grown in Virginia in 1887. "The acreage of the several crops ranges from more than sixty times as many in the case of corn down to four times as many acres in tobacco, which ranks next above potatoes in number of acres under cultivation. The value of an acre of potatoes, according to these statistics, is four times that of an acre of corn, more than four times that of an acre of wheat, nearly six times that of oats, and about two and two thirds that of hay. Tobacco alone exceeds it by one half in valuation per acre of crop." By high culture and the use of fertilizers, the authors are confident that the yield of potatoes in Virginia can be greatly increased. The variety tests at the station in 1889 were made to secure comparative data concerning earliness, yield, marketable quality, table quality, and general character of the tubers. The results are stated in tabular form for 33 early, 34 medium, 20 late, and 44 unclassified varieties.

The bulletin also contains brief notes on the potato rot (*Phytophthora infestans*).

The following are the authors' views on plat experiments as given in this bulletin: "In an experiment designed to have a direct, practical bearing upon field work, the larger the area, within certain limits, the more reliable are the results, considered on general principles. But in exact experiment work there must be a sharp limit to size of plat, and generally it is not a question as to how large the plats can be made, but what is the minimum size which can be used and obtain reasonably reliable answers to the questions proposed. The time and critical attention which must be given to an experiment makes it imperative that the area shall be reduced to the smallest compass possible. Hence, in an experiment like the one under consideration, the inquiry must be limited, and it must not be presumed that the results can be accepted as conclusive even on the points noted. The results, especially as to yield, on small-

plat experiments must, then, be afterwards put to the tests of larger areas. However, small-plat work gives valuable indications as to earliness, character, and quality of varieties. [In the experiments reported in this bulletin], the full size of plat was 20 feet long by 3 feet wide. * * * The full plat was nineteen hills; where a less number came to maturity, in calculating the yield per acre, the plat has, in all instances, been reduced to a perfect stand. The possibility of misleading results in yields so calculated is patent to all."

Wisconsin Station, Bulletin No. 23, April, 1890 (pp. 11).

PREVENTION OF APPLE SCAB, E. S. GOFF (illustrated).—This contains a brief, illustrated account of the apple-scab fungus (*Fusicladium dendriticum*, Fckl.), and details of experiments in the use of fungicides for this disease, conducted by the author and Mr. A. L. Hatch, of Ithaca, Wisconsin, in co-operation with this Department. These experiments are also reported in Bulletin No. 11 of the Section of Vegetable Pathology of this Department, pp. 22–29. As the result the author is confident that damages from apple scab may be almost entirely prevented at a slight cost by spraying the trees once in two or three weeks during the summer with ammoniacal carbonate of copper, of a strength not to exceed 1½ ounces of the carbonate and 1 quart of ammonia to 100 quarts of water.

EXPERIMENT STATION NOTES.

ALABAMA STATIONS.—The report on education adopted by the State Alliance at its last annual meeting contains the following references to agricultural education and investigation:

"We congratulate the State upon the growth of her State College in six years from a mere literary institute, with one hundred and twenty-seven students, to a grand polytechnic institute, with two hundred and fifty-four matriculates, and we are pleased to ascribe this growth to the development of the agricultural and mechanical departments of the college.

"We commend also the establishment of branch agricultural schools and experiment stations in different sections and upon typical soils of the State. We congratulate the State Experiment Station in calling to its aid co-operative experiments by farmers, cultivating typical soils of the State, to study the needs of our various soils.

"We indorse the holding of farmers' institutes as the most effectual means of carrying the school to the farmers, and believe that vast good may be accomplished by this means if actively and intelligently conducted. We recommend that the Commissioner of Agriculture be required by law to hold a farmers' institute in each county of the State annually, and be authorized to call to his aid the best local and farm talent at reasonable compensation for the service rendered.

"We recommend that any funds arising from the fees on commercial fertilizers not required for the maintenance of the Department of Agriculture, economically conducted, and not already appropriated for the benefit of the agriculture of the State, be appropriated for the establishment of local branch schools in different sections of the State, requiring the local authorities and citizens to furnish the buildings and land necessary for manual and practical training."

ARIZONA COLLEGE AND STATION.—F. A. Gulley, M. S., has been elected professor of agriculture and director of the station, vice S. M. Franklin, who, however, still remains a member of the governing board.

CALIFORNIA STATION.—A substation for Southern California has recently been established at Pomona, Los Angeles County, in conformity with the result of explorations made last season with the view of finding a locality reasonably representative of a region which includes both the coast from Santa Barbara to San Diego and the more or less arid lands of the interior. On the ground that the station should be situated within the great valley of that portion of the State (which reaches from Los Angeles to San Bernardino Mountain, and which is the largest and earliest settled track of agricultural land south of the San Joaquin Valley), a compromise location within that valley seemed to be best realized on or near the water divide between the two river systems that now drain it diagonally, viz., the San Gabriel and Santa Ana rivers.

As in former cases, the land for the station has been donated. The soil of the main tract of 30 acres is the reddish loam, which is considered specially favorable to the success of citrus fruits. The 10-acre tract is a fair sample of the black loam that constitutes most lands of this as well as of the coast region, is especially adapted to field crops of all kinds, and needs no irrigation. The two tracts lie about 2 miles apart. On the larger one the station buildings will be erected, with the aid of about

$3,000 subscribed by the citizens of Pomona. At a late meeting of the regents of the University of California, Mr. Richard Gird was appointed "Patron" of the South California Station. It is hoped that the buildings will be ready for occupation by November 1, and that the station will be fully stocked for the coming season's work.

Offers of land and of funds for buildings were also received from the citizens of Riverside; but the fact that the coast climate was entirely unrepresented in the work of the station prevented the location of the new substation at this place, where it would have been essentially representative only of citrus culture in the interior.

Papers on the following subjects were prepared by officers of the station for the recent meeting of agricultural chemists at Indianapolis: On further experiments regarding the reaction between alkali sulphates, calcic carbonate and free carbonic acid, by M. E. Jaffa, Ph. B.; and on the nitrogen contents of California wines, by L. Paparelli and G. E. Colby, Ph. B.

IOWA STATION.—The committee of the college board of trustees on the experiment station, as now constituted, consists of Dr. S. P. Yeomans, Charles City; Hon. Eugene Secor, Forest City; and C. M. Dunbar, Maquoketa. For experiments in feeding and dairying, with special reference to the comparative value of different breeds, the station has purchased a young bull and two heifers of each of the following breeds: Holstein, Galloway, Cruikshank, Shorthorn, Polled Angus, Jersey, and Red Poll.

LOUISIANA STATIONS.—T. S. Adams has been appointed commissioner of agriculture, vice T. J. Bird. In accordance with a recent act of the State legislature the stations are required to analyze Paris green offered for sale as an insecticide, under conditions prescribed by the State Bureau of Agriculture. By the same act a license tax of half a cent per pound is laid on all Paris green sold. The net proceeds of this tax are to be applied to the support of the experiment stations. A small, open-pan sugar-house has been erected at the North Louisiana Station, and additions have been made to the equipment of all three stations. The results of investigations on the "screw worm" will soon be published. Rains seriously affected the results of this season's experiments in making sugar from sorghum at the Sugar Experiment Station. The yield of cane was large, 15 to 20 tons per acre, but the sugar content was low, the highest being 10 per cent of sucrose and the average only 5 to 6 per cent. At a recent monthly meeting of the farmers' association at the North Louisiana Station there were present over one thousand farmers from twenty-five parishes.

NEW MEXICO STATION.—The corner stone of the college and station building was laid September 9 and it is expected that the building will be ready for occupancy by December.

NEW YORK STATE STATION.—Philip N. Nicholas, of Geneva, and Adrian Tuttle, of Watkins, have been appointed members of the board of control. W. A. Armstrong is no longer on the board.

NEW YORK CORNELL STATION.—J. M. Stedman, B. S., assistant in entomology, has resigned to accept a position in the Division of Economic Ornithology and Mammalogy of the United States Department of Agriculture.

PENNSYLVANIA STATION.—B. F. Robb, of Pittsburg, has been elected a member of the governing board, vice John Hamilton.

TENNESSEE STATION.—The station staff as recently organized includes F. L. Scribner, B. S., director and botanist; C. W. Dabney, jr., Ph. D., chemist; H. E. Summers, B. S., consulting entomologist; R. J. Cummings, farm foreman; and W. N. Price, assistant farm foreman. Other officers are yet to be selected.

VIRGINIA STATION.—Under the present organization of the station the board of control consists of C. E. Vawter, Crozet; J. E. Massey, Richmond; and J. T. Brown, Brierfield. The station council includes L. L. Lomax, president of the college, chairman; W. D. Saunders, director of the station; W. B. Alwood, and Walker Bowman, Ph. D. T. L. Watson, assistant in chemistry, and W. W. Hurt, clerk and stenographer, have been added to the station staff.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

AUGUST 1 TO SEPTEMBER 1, 1890.

DIVISION OF FORESTRY:
Bulletin No. 4.—On the Substitution of Metal for Wood in Railroad Ties.

DIVISION OF ENTOMOLOGY:
Periodical Bulletin, Vol. III, No. 1, August, 1890.—Insect Life.

DIVISION OF STATISTICS:
Report No. 76 (new series), August, 1890.—The Condition of Growing Crops.

OFFICE OF EXPERIMENT STATIONS:
Experiment Station Record, Vol. II, No. 1, August, 1890.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

AUGUST 1 TO SEPTEMBER 1, 1890.

AGRICULTURAL EXPERIMENT STATION OF COLORADO:
Bulletin No. 12, July 1890.—Some Colorado Grasses.

STORRS SCHOOL AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 6, August, 1890.—Grass and Forage Garden; Grasses and Legumes.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ILLINOIS:
Bulletin No. 10, August, 1890.—Investigations of "Milk Tests."
Bulletin No. 11, August, 1890.—Experiments with Wheat.

KANSAS AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 11, July, 1890.—Experiments with Wheat.

KENTUCKY AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 29, July, 1890.—Commercial Fertilizers

MARYLAND AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 9, June, 1890.—Strawberries.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:
Analyses of Commercial Fertilizers, August, 1890.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:
Meteorological Bulletin No. 19, July, 1890.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:
Bulletin No. 63, July, 1890.—Greenhouse Building and Heating.
Bulletin No. 64, July, 1890.—Fertilizer Analyses.

Agricultural Experiment Station of the University of Minnesota:
Bulletin No. 12, July, 1890.—Meadows and Pastures in Minnesota; American-grown Cauliflower Seed; Preserving Vegetables in Carbonic Acid Gas; Protection from Frost.

Missouri Agricultural Experiment Station:
Bulletin No. 12, June, 1890.—Black Leg in Cattle.

New Jersey State and College Agricultural Experiment Stations:
Bulletin No. 69, July 15, 1890.—Analyses and Valuations of Complete Fertilizers.
Bulletin No. 70, July 26, 1890.—Some Fungous Diseases of the Spinach.

New York Agricultural Experiment Station:
Bulletin No. 21 (new series), July, 1890.—Testing of Dairy breeds.
Bulletin No. 22 (new series), August, 1890.—Pig Feeding Experiments without Milk.

Cornell University Agricultural Experiment Station:
Bulletin No. 18, July, 1890.—Experiences in Spraying Plants.
Bulletin No. 19, August, 1890.—Report on the Condition of Fruit Growing in Western New York.

North Carolina Agricultural Experiment Station:
Bulletin No. 72b, July, 1890.—Meteorological Data.

Ohio Agricultural Experiment Station:
Bulletin Vol. I, No. 2, (technical series), May, 1890.—Flowering Plants on State University Grounds; Life History of Little-Known Plant Lice; Shells of Franklin County.
Bulletin Vol. III, No. 5 (second series), June, 1890.—Corn Silage *vs.* Sugar-Beets as Food for Milk Production.

Tennessee Agricultural Experiment Station:
Special Bulletin E, July, 1890.—The Cotton Worm: The Hessian Fly.

Virginia Agricultural Experiment Station:
Bulletin No. 7, July, 1890.—Variety Tests with Strawberries.

Agricultural Experiment Station of the University of Wisconsin:
Bulletin No. 24, July, 1890.—A New Method for the Estimation of Fat in Milk.

EXPERIMENT STATION RECORD.

Vol 2. NOVEMBER, 1890. No. 4.

EDITORIAL NOTES.

Among the recent foreign publications received is a report* to the Austrian Minister of Agriculture by Dr. Martin Wilckens, professor in the School of Agriculture (*Hochschule für Bodenkultur*) at Vienna, on the observations made in a tour in the United States and Canada from March to November, 1890, to investigate their agriculture. With this end in view he visited seventeen agricultural colleges and twenty experiment stations, besides numerous farms, agricultural exhibitions, manufactories of agricultural implements, etc. It is evident that Professor Wilckens entered upon his task with a willingness to see the desirable features in the agricultural systems and institutions of America. He has discovered much which he deems worthy of the highest commendation, and in some instances of imitation. In comparing the conditions existing in the United States and in Europe, the author calls attention to the greater dignity of manual labor in America, to the higher intelligence and better social position of the common farmer here, and to the close relations existing between our farmers and the scientific world. "One of the most striking illustrations of this," he says, "is the work of the United States experiment stations. The scientific workers of these stations * * * use every effort to make their researches intelligible to all, and to draw conclusions from the results of such work that will be of practical interest and use to the common farmer. For this reason the American experiment station workers become the leaders and guides of the farmers, and the experimental farms conducted by these State institutions are models of agricultural practice. We can, then, learn much from North American agriculture, and it is my hope that this communication may be instrumental in this direction."

The chapter on experiment stations contains an account of the establishment, history, organization, object, outfit, and financial resources of the stations as a whole, followed by short accounts of the twenty dif-

* Nordamerikanische Landwirtschaft. Tübingen, 1890, pp. 292.

ferent stations visited, including descriptions of prominent features in equipment, experiments under way, and results of recent investigations at each station, together with data showing the importance of certain lines of work to certain States. The buildings and outfit of the entomological departments seem to have particularly arrested his attention and are described at considerable length. The details regarding the stations and their work are given with an accuracy that indicates careful study and close observaton.

The author's general impressions of the stations are highly favorable. "The organization of the experimental work in agriculture in the United States," he says, "is worthy of admiration; and the generosity with which the publications of the stations are furnished to all having an interest in the work, both at home and abroad, deserves the highest commendation. I myself am indebted to this spirit of generosity in a high degree, receiving, as I do, the reports of a large number of the stations regularly, together with the publications of the Office of Experiment Stations, and as a result I am far better informed concerning the investigations and experiments of the American stations than I am concerning those of Europe. * * * A part of the publications of these stations would have little or no value to the European farmer; but they contain much of great practical value, as well as some features of scientific interest. Great weight is laid in the United States upon the importance of making the work of the stations of such an order that the results will be of direct benefit to the agricultural population. In addition to receiving the publications, many farmers visit, from time to time, the stations of their own States, for the purpose of becoming better acquainted with the work undertaken from viewing the experiments in progress, seeing new forage crops on trial, learning new methods of feeding, etc.

"The North American experiment stations stand in a much closer relation to the farmers of their respective States, and acquaint themselves to a greater degree with their scientific needs than is the case with the German stations. The American experimenter knows the practical side of the agriculture which surrounds him.

"It may be that the American stations sometimes make the mistake of publishing too much and too hastily, so that at times incomplete work, the results of which are not fully confirmed, is sent out. In general, however, they are faithful and conscientious agents of the farmers of their respective States, and prepare the way for progressive agriculture in the land."

ABSTRACTS OF BULLETINS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

Alabama College Station, Bulletin No. 14 (New Series), April, 1890 (pp. 40).

VALUE OF COW-PEA VINES AND ROOTS AS A FERTILIZER, N. T. LUPTON, LL. D. (pp. 5–9).

Comparative manurial value of vines and roots.—"Four samples were taken October, 1889, from a crop raised on the experiment farm, as follows: Sample A was taken from a space 1 yard square. The vines were carefully cut, leaving the usual amount of stubble with the roots. A trench was dug around this square yard to a depth of several feet, and the earth washed away by a stream of water from a suitable hose. The roots were collected as completely as possible. Samples B, C, and D were from a cubic foot each, selected at random in the patch; the earth was entirely removed, dried, and then carefully sifted from the roots. Care was taken to secure, as far as possible, all fibers, however small. It was found that in this soil, a sandy loam with sandy subsoil, the roots were virtually all included in the first foot in depth. Vines and roots, with stubble attached, were air dried and weighed."

The following table summarizes the weights of vines, and of stubble and roots with adhering earth, as observed; the weights for 1 acre as estimated by multiplying these by the number of square yards or square feet in an acre; the percentages of the most valuable ingredients, as shown by analysis; and the estimated weights of the same ingredients per acre:

Weights and composition of vines, roots, etc.

	A.		B.		C.		D.	
	Vines	Roots and stubble.	Vines.	Roots and stubble.	Vines.	Roots and stubble	Vines.	Roots and stubble.
Weights per plat, as observed..grams	210	67	137	20	58	11	69	9
Estimated weights per acre ...pounds.	2,236	713	13,128	1,916	5,558	1,054	6,612	862
Results of analysis:								
Moisture ....per cent.	11 79	10.95	10.49	11.10	11.48	9.05	11.04	9 53
Crude ash ....do...	14.37	20.65	8.87	23.54	7.81	18.18	7.31	17.53
Phosphoric acid ....do...	1.03	1.09	0.56	0.56	0.55	0.62	0.44	0.30
Potash ....do ..	1.24	1.17	1.25	1.11	1.33	1.24	1.35	1.14
Nitrogen ....do..	2.62	1.09	1.73	0.75	1.45	0.54	1.45	0.36
Valuable fertilizing ingredients in one acre, estimated:								
Phosphoric acid ....pounds	23.03	7.77	73.51	10.72	30.56	6.53	29.09	2.58
Potash .... do...	27.72	8.34	164.10	21.26	74 10	13.06	89.26	9.82
Nitrogen .... .do...	58.58	7.77	227.11	14.37	80.59	5.69	95.87	3.10

In the air-dried material the vines weighed from three to seven and one half times as much as the roots, the average being six times. Such variations are not surprising in observations on so small areas.

The commercial values of the valuable fertilizing ingredients in vines, roots, and stubble, taking the average of the four samples and assuming the phosphoric acid to be worth 7½ cents, the potash 5 cents, and the nitrogen 19½ cents per pound, are computed to be, vines, \$29.90; roots and stubble, \$2.67; total, \$32.57 per acre.

Loss of nitrogen in vines by lying on the ground.—Samples of dry vines which had lain on the ground during the fall and winter, were collected in the last weeks of December and January, and the percentages of nitrogen determined. The leaves had mostly disappeared, and it is noted that the data do not suffice for exact comparison of the amounts of nitrogen in the green vines as harvested in October and dried in the laboratory, with the amounts in the corresponding or dried materials as gathered from the ground in winter; or show how much of the nitrogen lost from the plants by loss of leaves, leaching, decay, or otherwise, had been taken and held by the soil. The results of the nitrogen determinations were as follows:

Percentages of nitrogen in air-dry material.

	A.	B.	C.	D.
Vines collected in—				
October	2.62	1.73	1.45	1.45
December	0.81	0.88	....	....
January	0.66	0.72	0.66	0.70

From these experiments and from results of late research regarding the acquisition of nitrogen from the air by leguminous plants, the following conclusions are drawn: "(1) Cow-pea vines contain a large percentage of phosphoric acid, potash, and nitrogen, the three valuable constituents of commercial fertilizers, and are especially rich in nitrogen, which they accumulate directly or indirectly from the atmosphere and furnish as a fertilizer to other crops. (2) In these experiments the vines weighed about six times as much as the roots, and were about eleven and one fifth times as valuable for a fertilizer, calculating their value on the basis of valuations used in Alabama for commercial fertilizers. (3) The vines lose a large percentage of their nitrogen when left on the ground during the fall and winter months."

FERTILIZER ANALYSES, N. T. LUPTON, LL. D. (pp. 10–40).—This contains tables of analyses of one hundred and seventy-nine commercial and other fertilizers, including phosphates, bone dust, muriate of potash, kainit, ammonium sulphate, tankage, bat manure, cotton-seed-hull ashes, cotton-seed meal, and green sand; guaranteed composition of commercial fertilizers licensed; list of licenses for season of 1889–90, and the fertilizer laws of Alabama.

Alabama College Station, Bulletin No. 15 (New Series), April, 1890 (pp. 6).

KEROSENE EMULSION, G. F. ATKINSON, PH. B.—Directions for the making and applying of kerosene emulsion as an insecticide.

Kansas Station, Bulletin No. 10, May, 1890 (pp. 14).

NOTES ON CONIFERS.—Suggestions as to planting and pruning evergreen trees are given, together with descriptive notes on the following varieties of conifers, which are considered desirable for planting in Kansas: red cedar (*Juniperus virginiana*), Austrian pine (*Pinus austriaca*), Scotch pine (*Pinus silvestris*), table-mountain pine (*Pinus pungens*), dwarf mountain pine (*Pinus montana*), pitch-pine (*Pinus rigida*), Southern yellow pine (*Pinus mitis*), white pine (*Pinus strobus*), Norway spruce (*Picea excelsa*), white spruce (*Picea alba*), Colorado blue spruce (*Picea pungens*), Douglas's fir (*Pseudotsuga douglasii*), Western silver fir (*Abies concolor*), Siberian silver fir (*Abies pichta* or *sibirica*), American arbor vitæ (*Thuya occidentalis*), Siberian arbor vitæ (*Thuya sibirica*), deciduous cypress (*Taxodium distichum*), gingko or maiden-hair tree (*Salisburia adiantifolia*), European larch (*Larix europæa*). There is also a list of twenty-two varieties which, as far as they have been tried on the station grounds, have failed to grow.

Kentucky Station, Bulletin No. 26, April, 1890 (pp. 30).

EXPERIMENTS WITH CORN, M. A. SCOVELL, M. S.—These include (1) experiments on the station farm in continuation of a series begun in 1888, and reported in Bulletin No. 17 of this station (See Experiment Station Record, Vol. I, p. 61); and (2) co-operative experiments with fertilizers for soil tests on farms in other parts of the State and on different geological formations.

Experiments on the station farm.—"The soil of the experiment station farm is what is termed a 'blue-grass' soil. It is derived from the lower silurian limestone, rich in phosphoric acid. The subsoil is a light-colored clay, so retentive as to make the soil deficient in natural drainage. The land is worn, having been in cultivation for many years. It is believed that no stable manure or other fertilizers were applied before the farm was purchased by the station." The season was favorable for corn in respect to both temperature and rain-fall.

Effects of fertilizers containing nitrogen, phosphoric acid, and potash. Experiment No. 1.—Nitrate of soda, 160 pounds per acre, dissolved bone-black (acid black), 320 pounds per acre, and muriate of potash, 160 pounds per acre, singly, two by two, and all three together, and land plaster, 160 pounds per acre, were applied on parallel plats of one tenth acre each, two plats being left unmanured. The experiment was a repetition of the one in 1888, with the same fertilizers on the same plats, except that the quantities were adjusted to the schedule proposed in

the conference of representatives of experiment stations at the U. S. Department of Agriculture, of which an account was given in Circular No. 7 of this Office. Field notes are given and the results stated in tabular form. The yields of corn on the unmanured plats, and on the manured plats which received no muriate of potash, ranged from 25 to 38 bushels per acre. On those which had muriate of potash, alone or in combination, the yield ranged from 77 to 94 bushels. The results of this season, 1889, were very similar to those of 1888. *Experiment No. 2.*—In this the conditions were the same as in experiment No. 1, except that sulphate of potash was substituted for muriate, and dissolved bone black for plaster. As in experiment No. 1, there was a large increase of yield (40 to 47 bushels per acre over the unmanured plats) wherever the potash salt was used, and little or no apparent effect from the other materials. As between the sulphate and muriate the difference, if any, was in favor of the latter.

Financial results from the use of various fertilizers on corn.—Without taking into account the value of the stover, it appears that there was a profit in every instance where potash fertilizers were used, and a loss where dissolved bone-black and nitrate of soda were used without potash. "The results would indicate that soils of like character in the 'Blue-Grass' region would be benefited by fertilizers containing large quantities of potash, but the conclusions reached should not be considered as being applicable to the soils of the other geological formations of the State."

The permanency of the effect of fertilizers.—In 1888 a field of one acre was divided into ten equal plats, two of which were left unmanured, and eight treated with a mixture of sulphate of potash, sulphate of ammonia, and dried blood. In 1889, three of the plats manured in 1888 were left without manure, and the others received respectively muriate of potash, sulphate of potash, kainit, cotton-seed meal, and tobacco stems. The tabulated statement of the results of the second season shows clearly that the fertilizers applied in 1888 were of benefit both in 1888 and in 1889.

Relation of fertilizers to shrinkage and proportion of kernel to cob.—"In the previous results given, we have based our calculations on the weights of field corn, because that is the way corn is generally marketed here. It is evident, however, that its true value for feeding purposes depends upon the dry matter it contains and the proportion of corn to cob.

"For the purpose of studying this question, the corn [from eight experimental plats], after being husked and weighed, was spread over the floor of the barn loft and allowed to cure from November 11 to January 24. The loft is well ventilated. January 24 it was again weighed and shelled and samples sent to the laboratory for analysis." A table is given showing, for the eight differently fertilized plats, the number of ears in a bushel of 70 pounds; per cent of shrinkage of the ears, which

ranged from 12.3 to 29.5 per cent and averaged 18.4 per cent of the weight of the field cured; and the proportion of kernels to cob, which ranged from 18.5 to 21.4 per cent and averaged 19.9 per cent. According to this table neither the shrinkage nor the proportion of kernel to cob would seem to have been influenced by the fertilizers applied.

Does the application of fertilizers have any relation to the amount of phosphoric acid, nitrogen, and potash taken up by the crop?—The crops from six plats, used in experiments Nos. 1 and 2, including two unfertilized, were taken and analyses made of the corn, stover, and cobs from each. The tabulated results show that in no instance was as much potash or phosphoric acid taken up by the crop as was applied in the fertilizer. The maximum crop contained over threefold the amount of nitrogen applied in the fertilizer.

Co-operative experiments with corn.—In order to test the soils of other geological formations of the State, a series of co operative experiments was begun in 1889. The fertilizers were mixed at the station and sent out labeled and accompanied by directions to be followed by the farmers co operating. Nitrogen was supplied in a mixture of nitrate of soda, sulphate of ammonia and azotine; phosphoric acid as dissolved bone-black; and potash as muriate. The fertilizers were applied singly on three plats, two by two on three, and all together on one, one plat receiving land plaster, and two no manure. The plan of the experiments was approximately the same as that proposed in the conference of representatives of experiment stations, already alluded to, the chief difference being that nitrogen was supplied in the mixture mentioned rather than in nitrate of soda alone.

The trials were made on fourteen farms, on the upper and lower subcarboniferous, carboniferous, lower silurian, and quaternary formations. Each report gives notes on the weather, the crop at different stages of growth, and yields of corn and stover. The results varied widely, and there were several failures. "The experiments will, in all probability, have to be continued for several years before general conclusions can be reached."

Kentucky Station, Bulletin No. 27, April, 1890 (pp. 11).

EXPERIMENTS WITH COMMERCIAL FERTILIZERS ON HEMP, M. A. SCOVELL, M. S.

Effect of potash, phosphoric acid, and nitrogen, used in various combinations, on the production of fiber.—The field used for this experiment was "very much worn and would be considered by most farmers unfit for hemp." The plats were each one fortieth of an acre. A description of the treatment of the field, fertilizers applied, and method of planting is given, together with field-notes. From the tabulated statement of results it appears that nitrate of soda and muriate of potash, singly and combined, materially increased the yield; that phosphoric acid had very little effect; that the combination of muriate of potash and nitrate

of soda produced as large a yield as when phosphoric acid was also added; but that the best quality of fiber resulted from applying all three together. "These results suggest, therefore, that a fertilizer containing a large per cent of potash and nitrogen and a small quantity of phosphoric acid would be the most beneficial on our soils for hemp."

Financial results.—The value of fiber from the plat fertilized with nitrate of soda and muriate of potash, calculated for 1 acre, is estimated at $60, and the net profit at $24.

Muriate vs. sulphate of potash for hemp.—The results indicate that it makes little difference as to the quality and quantity of the yield which form of potash is used. The muriate being cheaper would be preferable.

Form of nitrogen for hemp.—It being the opinion among hemp growers that a rapid, vigorous growth at the start is of the utmost importance, nitrogen in its most available forms only was used for comparison. Very little difference was noticeable between the effects of nitrate of soda and sulphate of ammonia, but the quality was slightly superior with the nitrate.

Necessary amount of potash and nitrogen.—From trials in this direction the author concludes that 160 pounds of nitrate of soda or 120 pounds of sulphate of ammonia and 160 pounds of either muriate or high grade sulphate of potash will furnish all the nitrogen and potash required; whether a less quantity would be sufficient remains to be tested. A commercial fertilizer containing about 6 per cent available phosphoric acid, 12 per cent of actual potash, and 4 per cent of readily available nitrogen is suggested for hemp on soils and under conditions similar to those in the experiment here reported.

Louisiana Stations, Bulletin No. 26 (pp. 39).

REPORT OF STATE EXPERIMENT STATION FOR 1889, D. N. BARROW, B. S. (pp. 418–451).

Potatoes (pp. 418–430).—Under this head are reported experiments with varieties, fertilizers, and methods of planting. Drought seriously interfered with the success of these experiments.

Tests of varieties (pp. 418–426).—Three hundred and three varieties were tested on plats; the calculated yield per acre for each variety is given in a table; and 32 varieties of the greatest promise are briefly described. The experiment indicates the influence of a particular soil and climate on different varieties. Some varieties which are highly prized elsewhere proved a total failure at this station, while others not highly esteemed in other places have done excellently here. These tests will be continued.

Experiments with fertilizers (pp. 426–428).—Cotton-seed meal, acid phosphate, and kainit, singly and in combination, were applied to nine different varieties of potatoes. The results, which are stated in a table, were inconclusive as to the specific effects of the fertilizers, though pot-

ash seemed to be more effective with potatoes than with other crops experimented upon by the station, and the mixture of cotton-seed meal, acid phosphate, and kainit brought the best results. There was nothing to show that the different varieties were differently influenced by the same fertilizers.

Experiments with methods of planting (pp. 428–430).—Whole potatoes, halves, quarters, two-eye and one-eye pieces of seven different varieties were planted. The yields are stated in a table. The whole potatoes gave the best results.

Small and large fruits—tests of varieties (pp. 430–434).—Tabulated notes on 47 varieties of strawberries, with descriptive notes on the 12 varieties which gave the best results; brief notes on 5 varieties of raspberries, 1 of blackberries, 4 of peaches, and 6 of plums.

Grain, grasses, and vegetables (pp. 434–436).—Brief notes on experiments with oats, wheat, grasses, and clovers, and a number of different kinds of vegetables.

Live stock (pp. 436, 437).—Brief notes regarding the Jersey and Holstein cows, and the breeds of poultry belonging to the station.

Cotton—field experiments with fertilizers (pp. 437–441).—These were special nitrogen, phosphoric acid, and potash experiments, similar to those previously reported in Bulletin No. 21, of this station (See Experiment Station Record, Vol. I, p. 70). For various causes, which are stated in the bulletin, the results were inconclusive.

Field experiments with corn (pp. 441–444).—These were similar to those reported in Bulletin No. 21, of this station (See Experiment Station Record, Vol. I, p. 69), and were made to get light upon the questions as to what varieties are best adapted to the soil and climate of Louisiana, and what kinds and qualities of fertilizers are to be recommended for corn on the soil used in the experiments. Yields are reported for eighteen varieties, but the crop was severely injured by drought. The fertilizer experiments with corn were on the same plan as those with cotton, and the results were equally inconclusive.

Sugar cane (pp. 444, 445).—Reports of analyses of cane grown with different fertilizers.

Sorghum (pp. 445, 446).—Reports of analyses of the juice from 35 varieties.

Cotton—tests of varieties (pp. 446–454).—Tabulated notes on 38 different varieties, including data for the yield of seed cotton and of lint per acre, and the per cent of lint and of seed. The results at this station as compared with those at the North Louisiana Station, show a striking difference in the per cent of lint yielded by the same varieties, in nearly every instance the yield being greater at the latter station.

Louisiana Stations, Bulletin No. 27 (pp. 45).

REPORT OF NORTH LOUISIANA EXPERIMENT STATION FOR 1889, J. G. LEE, B. S. (pp. 455–497).—During 1889, 30 acres of the poorest land on

the station farm have been laid out in plats for field experiments with various crops. Besides this, 20 acres are devoted to grains, grasses, and clovers; 10 acres to vineyard, orchard, garden, and truck patches; 50 acres to general field crops, and the remainder is divided into pastures for different breeds of stock. Pigs and sheep of different breeds have been added to the live stock of the station as previously reported.

The station has recently erected a large and commodious hall, 40 by 60 feet, built for the purposes of the North Louisiana Agricultural Society, which holds its meetings here the last Thursday in each month. The organization of this society dates from the establishment of this station. Its officers are J. M. White, of Lincoln, president, and L. G. Drew, of Ouachita, secretary. The society is composed of farmers and planters of North Louisiana, and its good work in promoting agriculture and agricultural methods and implements, is already felt throughout this portion of the State.

Farmers of this section are enthusiastic over the station and attend in large numbers the monthly meetings of the society in Agricultural Hall. The railroads have liberally contributed to this movement by running excursion trains on the day of meeting from Vicksburg and Shreveport, thus giving the farmers, at a reduced cost, an opportunity of inspecting the work of the station and of enjoying the benefits of the discussions of the North Louisiana Agricultural Society.

A silo was erected in the barn during the summer and successfully used. The station orchard is in good condition. Variety tests have been instituted with oats, barley, wheat, clovers and other legumes and grasses. A rotation of oats, peas, corn, and cotton has been begun on three plats, with a view to getting light on the value of this system for renovating worn-out soils.

Field experiments with cotton (pp. 462–476).—These include experiments on the manurial requirements of cotton on the soil of the station farm, tests of varieties, and of different distances of planting.

Effects of fertilizers on cotton (pp. 462–469).—These were special nitrogen, phosphoric acid, and potash experiments, similar to those above referred to as made at the State Experiment Station (See Bulletin No. 26), as well as to those reported in Bulletins Nos. 20, 21, and 22 of the Louisiana Stations (See Experiment Station Record, Vol. 1, p. 63). The questions propounded on the respective plats were: (1) Does this soil need nitrogen (or phosphoric acid or potash) to grow cotton successfully? (2) If so, in what form can it be best applied? (3) In what amounts per acre?

Special nitrogen experiments.—Nitrate of soda, "mixed minerals," sulphate of ammonia, cotton-seed meal, cotton seed, compost, and kainit, were used singly and in various combinations, and compared with no manure. The results, as in previous experiments at this station, indicate that these particular soils need nitrogen very badly, but it is not so clear which is the best form to use. Cotton-seed meal gave results slightly better than any of the others, with cotton seed next. This, of course, simply tends to show that cotton seed or cotton-seed meal is a good form in which to apply the nitrogen, without prejudice to the claims of other forms, which may be excellent in their way. From a financial standpoint it seems probable that more than 24 pounds of

nitrogen per acre can not be used with profit, especially on very poor soils.

Special phosphoric acid experiments.—Gypsum, dissolved bone-black, acid phosphate, bone meal, floats, and a basal mixture (cotton-seed meal and kainit) were used alone and in various combinations, and compared with no manure. Variations in soil seem to have interfered with the success of this experiment, though it seems probable that phosphoric acid in small quantities may be profitably applied to this soil.

Special potash experiments.—Cotton seed meal and hull ashes, meal phosphate (cotton-seed meal and acid phosphate), kainit, and muriate and sulphate of potash were used alone and in various combinations. The conclusion reached was that "potash has not been beneficial to cotton on this soil in any form or quantity."

Proper depth for applying fertilizers for cotton (pp. 469, 470).—The questions considered were: (1) At what depth are fertilizers most available for cotton? (2) Is it best to apply the fertilizing ingredients separately and at different depths? The experiments reported were undertaken merely to obtain suggestions which might be of service in planning future investigations in a more complete way. The results seemed to indicate that a depth of 2 or 3 inches is the best one at which to apply "complete" fertilizers on this soil.

Tests of varieties of cotton (pp. 471–473).—Tabulated notes are given for 38 varieties, but for reasons stated in the bulletin the tests were inconclusive.

Distance of planting (pp. 473, 474).—Cotton was planted in drills at different distances and the results reported in a table. Incidentally the effect of "topping" the stalks was tested.

Effect of more than one application of nitrogen for cotton (pp. 474–476).—Various fertilizers containing nitrogen were applied once, twice, or three times during the same season. The results, as stated, indicate that little effect was produced by the second and third applications.

Field experiments with corn (pp. 476–482).—These included experiments with fertilizers and tests of varieties. The former were similar to those with cotton, above cited, and to previous experiments with corn reported in Bulletin No. 22, of this station (See Experiment Station Record, Vol. 1, p. 72). The results pointed in the same directions as in the case of cotton. Tabulated data are given for twenty varieties of corn.

Experiments with sorghum, sugar-cane, forage plants, etc. (pp. 483–490).—Brief accounts are given of tests of varieties of sorghum, sugar-cane, millo maize, teosinte, serradella, soja bean, pea-nuts, chufas, cow-peas, water-melons, and sundry forage plants, as well as of fertilizer experiments with sweet-potatoes and rice. Analyses of samples of sugar cane raised at the station and elsewhere in North Louisiana, are reported. The station intends to conduct experiments in sugar making with a view to the introduction of that industry in North Louisiana.

Experiments with potatoes (pp. 490-497) —These include tests of varieties and field experiments with fertilizers and methods of planting. Tabulated notes are given for eight varieties. In the fertilizer experiment cotton-seed meal, cotton seed, acid phosphate, and kainit alone, and these and nitrate of soda and sulphate of ammonia in various combinations were applied to Boston Peerless potatoes. Here, as in other fertilizer experiments at this station, nitrogen proved beneficial. The best yields were with crushed cotton seed or cotton-seed meal combined with kainit and acid phosphate. Tabulated notes are given for experiments in planting large and medium sized whole potatoes, and one-eye, two-eye, and larger pieces of the eight varieties tested.

Louisiana Stations, Bulletin No. 28 (pp. 52).

FIELD EXPERIMENTS ON SUGAR-CANE (pp. 500-549).—A series of experiments begun in 1886 was closed at the end of the season of 1889. For a previous report on these experiments see Bulletin No. 20 of this station, and Experiment Station Record, Vol. I, p. 63. This bulletin contains the details of the experiments in 1889, and a summary of the results for the four years. During the first three years the station was located at Kenner, and during the last year at Audubon Park, New Orleans. The investigations have included field experiments on germination and growth from "plant cane," and from stubble under different conditions; physiological questions, including the influence of suckering on the cane; varieties, with reference to their adaptation to Louisiana; and manurial requirements.

Meteorology (pp. 500-503).—A condensed weather record for each month from March 1, 1886, to January 1, 1890, is given from observations made at the station, as well as a summary by years and seasons. In 1886 the winter was severe, the spring late and cold, and the summer and fall favorable; in 1887 the winter was mild, the spring moderately dry and warm, the summer warm and wet, and the autumn cool and dry (conditions favorable to heavy tonnage of cane); in 1888 the winter was fairly propitious, the spring excessively wet, the summer wet, and the autumn dry and cold (light tonnage but heavy sugar yield due to relatively low glucose content); in 1889, the spring and fall were exceedingly dry. "We find that a dry, warm winter, followed by a moderately dry spring, and this, in turn, succeeded by a hot, wet summer, shading gradually into a cool, dry autumn, are conditions favorable to a maximum growth of cane. After the cane is 'laid by' frequent showers of considerable intensity seem highly beneficial."

Germination questions (pp. 504-519).—"The sugar-cane has been so long cultivated from cuttings that it has, like the banana, lost its power of producing true seed, even though it passes through all the phases of fructification. Often in nature, when any organ is rendered useless, it ceases to exist. The fish in underground caverns are eyeless. The banana and some other plants, long propagated from shoots

or suckers, produce seedless fruits. In the last year or two, however, the cane has been made to produce true seed. The idea by which this result was achieved was in itself a simple one, yet the thought may produce a revolution in cane culture. Professors Harrison and Bovell, of Dodd's Reformatory, Barbadoes, conceived the idea that by placing in close proximity unlike varieties of cane from different parts of the world, by cross-fertilization, perfect fructification might result." Experiments with this method at this station and elsewhere have already resulted in the production of several new varieties of great promise.

Part of the cane best for seed.—The question whether the upper part of the cane may be used successfully for seed is discussed and the results of experiments in planting different parts of the stalk are recorded and compared with those of similar experiments in previous years. The plan of these experiments was in brief as follows: "The stalks were cut up into short pieces, beginning with the green, immature top, and ending with the butts. Two eyes were left upon each cutting, and each stalk was selected so as to give eleven cuttings. Seventy-five of these cuttings, containing one hundred and fifty eyes, were devoted to each experiment." There were thus eleven experiments, one for each of the parts into which the stalks were cut. Observations for each experiment included the number of stalks from the one hundred and fifty eyes planted; development at different dates during growth; yield of stalks; results of chemical analyses, including degree Baumé, total solids, sucrose, glucose, co-efficient of purity and glucose ratio of juice; and total calculated yield per acre of stalks and of available sugar, etc.

Number of stalks of cane to plant.—Plant vs. stubble cane for seed.—In 1889, as in 1887 and 1888, different plats were planted with cane in different degrees of thickness (from one cane with a lap to four canes with a lap) in rows 7 feet apart. The whole cane, upper and lower halves, and upper, middle, and lower thirds, were used in different rows. The results for these years are stated in tables. In 1889, as in 1888, one half the field was newly planted, but the other half was allowed to grow from stubble of the previous year. "Observations on germination and on development, produce of stalks, chemical composition of cane, and yield of sugar were made as in the experiments described above."

Vitality of eyes in whole canes planted.—Some persons recommend cutting the cane for seed because they believe that "when an eye or an entire stalk starts vigorously into growth it can and may injure the vitality of the other eyes" on the same stalk. To get light on this subject experiments recorded in this bulletin were undertaken. In thirteen experiments two whole canes of about 4 feet in length were planted in trenches, with their tops and butts from 3 to 24 inches deep, and in another experiment one whole cane was planted perpendicularly, top up and butt down. The canes were planted March 13 and dug November 14 and 15, when "the growing canes were removed and counted, the mother stalk carefully washed and examined, and each eye carefully treated as regards germination and soundness." Notes on each

cane are given, which indicate that the opinion cited above is not well founded. The observations also "suggest the immense power residing in a good sound eye of cane."

Distance between cane rows (pp. 519–524).—Experiments were made in 1889 with stubble, similar to those in 1888 with plant cane, planted in rows from 3 to 8 feet apart and treated with commercial fertilizers. The yield of cane, composition, and available sugar are given separately for 1888 and 1889, and the results as regards yields and available sugar for the two years are compared. To plant an acre in cane, using "two stalks and a lap" for seed, will require 9¼ tons of cane per acre if the rows are 3 feet apart, and 3½ tons of cane if the rows are 8 feet apart. Subtracting these quantities from the average yields obtained in the experiment for the different widths of planting, the net product of cane per acre over the amount used for seed ranged from 44.15 tons with three-foot rows to 31.66 tons with eight foot rows. The results confirm those of last year, which were very favorable to a distance between the rows much less than the usual distance of 7 feet.

Among the suggestions from these experiments is a query by the author whether the frequent rupture of the roots by the very thorough cultivation of the cane, and the more luxuriant growth of grass and weeds permitted by wide rows, do not, to a large extent, explain the belief of planters that "cane never grows well until laid by" and that "cane never grows fast until it shades the ground."

Varieties of cane (pp. 524–526).—"The station has now growing over sixty varieties of cane, collected from all parts of the world. It has received since our last report thirty-five varieties from the botanical gardens of Jamaica." The results have so far been somewhat contradictory, varieties which were at first promising not fulfilling expectations in later seasons, and others at first unpromising giving better results as they become acclimated. No foreign variety, however, has been sufficiently acclimated to warrant positive statements regarding its merits for Louisiana. The station is also studying the synonymy of varieties and making experiments in cross-fertilization.

Manurial requirements (pp. 526–545).—In 1889 the station continued its experiments "to find a fertilizer which will produce a maximum tonnage with a maximum sugar content upon the soils of Louisiana." The results for that year are given and compared with those of previous years. The experiments include special nitrogen, phosphoric acid, and potash experiments, and trials of cotton-seed meal and tankage alone, and in combination with acid phosphate, floats, kainit, ashes, cotton hulls, etc. The effects of tile drainage and of removing or turning under pea-vines on stubble cane were also tested in connection with the use of fertilizers.

Summary of results for four years (pp. 546–549).—The following are some of the conclusions taught by the results of the last four years:

(1) That the upper portion of the cane is the equal, if not the superior of the lower part for seed, while the latter is vastly superior as a sugar producer.

(2) That with good seed, two stalks and a slight lap will give an abundant harvest, and no more is needed.

(3) That seed cane may be selected from either plant or stubble.

(4) That suckering (tillering) is a natural function of all cereals and should be encouraged to produce the best results.

(5) That rattoons come equally as well from suckers as from the original stalk.

(6) That cutting cane in planting is not necessary to insure successful germination, the latter being dependent upon other conditions.

(7) That the vital power of good, sound eyes is enormous, enabling the latter under favorable conditions of heat, moisture, and access of air to germinate at great depths, or even remain dormantly sound for over a year when properly protected.

(8) That the present width of rows may be lessened (when the soil will permit of easy cultivation) with promise of increased production.

(9) That several varieties of foreign canes promise adaptability to our wants.

(10) That both nitrogen and phosphoric acid are needed by our soils to grow maximum crops of cane. That excessive quantities of each should be avoided, the former as being positively injurious and the latter as being redundant and wasteful.

(11) That while sulphate of ammonia gives slightly the best results, and fish scrap slightly the worst, it may be asserted that any form of nitrogen experimented with will give remunerative returns when properly compounded and used in such quantities as to furnish from 25 to 50 pounds nitrogen per acre.

(12) That phosphoric acid, when applied at or after planting, should be in a soluble state, in quantities of 32 to 64 pounds per acre. Even the latter might, with propriety, be applied before the crop is planted. That insoluble phosphates should always be applied some time in advance of the planting.

(13) That no form of potash is preferred by the cane plant, and that small quantities neither increase the tonnage nor the sugar content.

(14) That mineral manures (phosphates and potash) when applied alone are without much effect. To be available they must be combined with nitrogen.

(15) That nitrogen is most cheaply supplied to the planters of Louisiana in the form of cotton-seed meal, and experiments have demonstrated that its profitable limits are between 300 to 600 pounds per acre under cane.

(16) That tile drainage is a very valuable amendment to the soils of South Louisiana, and when properly done will pay a handsome dividend upon investment. Experiments indicate that best results are obtained when tiles are placed from 20 to 30 feet apart.

(17) That pea-vines turned under give an increased yield to the subsequent crops, extending even to the second year's stubble.

(18) That the stubble from canes properly manured will give profitable crops for several years, while that unmanured, or improperly fertilized, will fail in a year or two.

(19) That manures can be prepared which will give tonnage, but no special manure has yet been found which will insure a large sugar content. The latter seems to be largely dependent upon soil, sunshine, temperature, moisture, and climate.

These are the deductions from the work of the past four years, and may be modified by future investigations. The question of the proper manuring of cane is not yet settled.

The varying meteorological conditions of different seasons, especially as regards rain-fall, are an important and uncertain factor in the use of fertilizers for sugar-cane. It seems quite settled that fertilizers should be applied so as to promote vigorous growth from the time of germination until September when the plant should be permitted to mature. What would be an excessive manuring in a dry season may be inadequate in a very favorable season. The experiments at this station in-

dicate that in an average season from 24 to 48 pounds of nitrogen and 40 to 75 pounds of phosphoric acid (the amounts contained in from 350 to 700 pounds of cotton-seed meal and 300 to 600 pounds of acid phosphate) per acre can be assimilated by the crop. Such a mixture is recommended for its cheapness and efficiency. Each planter should study his soils, and if they are deficient in vegetable matter should increase the amount of nitrogen in the fertilizers used. There are few seasons when more than 900 or less than 500 pounds per acre of this mixture can be profitably used. The fertilizers should be thoroughly incorporated with the soil. Mineral manures should be applied at, or better, before planting; nitrogenous manures may be applied at planting or at any time during early growth.

Massachusetts State Station, Circulars, May and June, 1890 (pp. 4 each).

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES, C. A. GOESSMANN, PH. D.—These include wood ashes, bone, "vegetable ivory," refuse from a glue factory, sulphate of ammonia, sulphate and muriate of potash, nitrate of soda, and a variety of compound fertilizers. Trade values of fertilizing ingredients for 1890 are also given.

Minnesota Station, Bulletin No. 11, June, 1890 (pp. 32).

CORN—ROOT PRUNING, AND DEEP VERSUS SHALLOW CULTIVATION, W. M. HAYS, B. S. A. (pp. 87-89.)—Experiments and observations on the habits of root growth of corn and on methods of planting and cultivating in 1888 and previous years were reported in Bulletin No. 5 of this station (See Experiment Station Record, Vol. I, p. 91). In 1889 a trial was made to observe the effects of pruning the roots of Rose Dent corn. The roots of alternate rows were pruned while the others were not.

For pruning the roots, a strong butcher knife was set into a piece of 2 by 6 scantling, fashioned into a runner, to slide on the ground. In front was a tongue, by which a man could pull the device, and behind, cultivator handles were placed, enabling another man to guide it. The knife blade was set in the runner so as to extend 6 inches into the ground, when the runner was on the surface of the soil. This implement was run along either side of the rows, 6 inches from the hills. Plats 1, 3, 5, and 7 were thus root pruned, by going the long way of the rows, when the corn was 7 inches high. On the same day the roots on plats 1 and 3 were more completely cut off by going across the field, skipping every other hill, so as not to disturb the even-numbered rows on plats 2 and 4. This, of course, cut all the roots on plats 1 and 3 at a distance of 6 inches from the hills, on four sides, since all the main roots while the corn is at this age run in a nearly horizontal direction, unless the land is very dry.

When the corn was 15 inches high, plats 1, 3, and 5 were again root pruned the long way of the rows, and plat 1 was also root pruned crosswise. Passing on both sides of the hill being counted as one pruning, plat 1 was pruned four times, plat 3 three times, plat 5 twice, and plat 7 only once. The effect upon the growth of the corn was very marked.

The yields of grain and fodder for each plat are given in a table. The average yield on the root-pruned plats was at the rate of 35 bushels per acre, and on those not root pruned, 48½ bushels. The average difference in yield per acre was 13½ bushels of corn and one quarter ton of fodder against root pruning. The difference in yield was most marked on those plats where the most root pruning was done.

This is a strong confirmation of previous observations, which had shown the author that great injury is done to corn "by deep, close culture with the ordinary four-shoveled, two-horse corn cultivator, or with the 'double-shovel' plow. Plowing deep and close to the hills is harmful at any time, but is especially so late in the season, as the larger roots, developed late, as well as those which originated on the stalk earlier in its development, are severed." In another experiment, performed just as the corn was "laid by," two rows were root pruned 5 inches deep and 8 inches from the hill. Two rows were hilled up 4 inches with a hoe, and two other rows were left untouched. The tabular record shows that no apparent effect was produced by the hilling, but that the root pruning though slight, lowered the yield 3 bushels per acre, the average yield of the root-pruned rows being 57 bushels per acre, and that of the rows not pruned 60 bushels.

Brief statements are made regarding the best kinds of implements for cultivating corn. "Some of the shallow cultivators used at this station the past season are more satisfactory than the common four-shoveled, two-horse corn cultivator. * * * The very best cultivator is the smoothing harrow. It should be diligently used until the corn is 4 or 5 inches high."

Corn improved by cross-fertilization and selection, W. M. Hays, B. S. A (pp. 89–95).—During the past two seasons the writer has made observations and experiments with reference to the best methods of growing, cross-fertilizing, and selecting corn with a view to the development of varieties especially suited to particular localities and uses. This work is especially important in the region of the station, for "along the northern edge of the corn belt no such clearly defined varieties are found as farmers have developed in sections farther south where corn is king." In 1888, as reported in Bulletin No. 7 of this station (See Experiment Station Record, Vol. I, p. 97), ears of numerous varieties were fertilized with pollen of other varieties, the ears being covered with bags made of cloth or paper to prevent the access of pollen to the silk in the ordinary way. Examples of these experiments are described to show how radically the form of the ear, kind of grain, etc., can be changed by artificial fertilization and careful selection of seed. The engraving printed in the bulletin represents some interesting results of cross-fertilization, showing reversion to more or less remote ancestors.

In 1888 Mercer Yellow Flint was planted at the station not far from Black Mexican sweet-corn; at harvest one to several black grains were found on several ears of the Mercer Flint; a dozen of these dark-col-

ored grains were planted in 1889 in such a way that the plants were out of the reach of the pollen from other varieties. Ears were produced which proved that the Black Mexican corn had fertilized dark-colored grains on the ears of Flint the previous year. Besides the Yellow Flint and the Black Sweet grains, there were Yellow Sweet, Black Flint, White Sweet, and White Flint grains on nearly every ear. The appearance of White Sweet grains is explained on the assumption that the Black sweet-corn had at some previous time been mixed with a very light-colored variety of sweet-corn, while the White Flint grains may have come from a previous ancestor of White Flint, or even White Sweet. Moreover, the fact that on several of the ears were grains of sweet-corn of a reddish or flesh-colored tint, peculiar to a variety of sweet-corn called Early Narragansett, may indicate that this variety was among the ancestors of the Black Mexican Sweet.

"The practical lesson taught by the example of an ear with the six or seven kinds of corn shown is that we must 'breed' our corn for a number of years pure, and carefully select the seed, according to some type, if we would have distinct varieties. The principles of heredity may find as practical application in breeding corn as in breeding cattle. * * * Here both parents probably had recently been crossed with different varieties, and the different ancestral characteristics reappeared and determined the form or color, or both, of some of these kernels. * * * So, in corn growing, it pays to keep seed pure. Retain one intelligently selected type, and by cultivation and selection, and even by cross-fertilization, improve and 'fix' the desired type. * * * Farmers in every corn-growing locality should develop varieties of corn suited to the existing conditions and raise seed for sale." Practical suggestions as to the ways for doing this are given.

PEAS, BEANS, FLAX, AND OTHER CROPS, W. M. HAYS, B. S. A. (pp. 95–98).—Under this head are given brief notes on tests of 3 varieties of horse beans, 7 of cow-peas, 6 of field pears, 2 of garden peas, oats and peas sowed together, 3 varieties of buckwheat, and 3 of millet.

RESULTS OF SEEDING RUSTED, FROSTED, AND FROZEN WHEAT OF 1888, D. N. HARPER, PH. D. (pp. 99–116).*—The object of the observations and experiments reported in this article was to study the characteristics of "poor wheat," so called, and the effects of frost, rust, and other injurious agencies upon its value for milling and for sowing. The smoother the hull of wheat the more easily and economically can it be milled, and if for any reason the hull has been seriously injured the value of the wheat for making "patent" flour is decreased. Injuries to the hull may not affect the germ or the interior of the grain, so that wheat which grades low for milling may be of good quality for seed. In 1888 much of the wheat failed to grade high for milling, and was,

*For previous reports on this same general subject, see Bulletins Nos. 5, 6, and 7 of this station, abstracts of which may be found in Experiment Station Record, Vol. 1, pp. 91–100.

therefore, indiscriminately classed as "poor wheat." When this poor wheat was used for seed it sometimes yielded good crops and sometimes failed to produce any crop. In many cases this difference in results was thought to be purely accidental, or, in case differences in the seed used were observed, poor returns were attributed to a lack of vitality in the injured grain or to the slow growth of grain from "frozen" seed. But the fact generally lost sight of was that the causes which produce "poor wheat" are different in different cases, so that really there are more or less distinct classes of such wheat, which, if used for seed, will give diverse results. The author of this article has attempted a classification of the varieties of "poor wheat," according to the cause of the injury to the grain, into bleached, rusted, blistered, and frozen wheat.

Bleached wheat is defined as wheat which after harvest has been exposed to rains and the heat of the sun until the outer envelope of the grain is opaque and brittle. Ordinarily this does not affect the usefulness of the wheat for seed. *Rusted or blighted wheat* is more or less shrunken in appearance, and is usually of a deeper amber color than is normal. The proportions of its chemical constituents are somewhat changed, though their properties remain the same. The rusted wheat of 1888, as far as examined, contains more than the normal amount of gluten and protein and less of starch. "It is a poor wheat for milling because of the bad condition of the hull," but if not too much injured may be used for seed, as is indicated by the results of the experiments here reported. *Blistered wheat* retains its normal amber color, but has a brittle hull, and in many cases contains more gluten and protein and less starch than sound wheat. "As blisters may be caused by other means than frost, and even after the wheat is cut, it is not correct to call all such wheat *frosted*." Except in extreme cases, it may be safely used for seed if well cleaned. Cured wheat is not affected by the lowest temperature which occurs in Minnesota, but a temperature only a few degrees below freezing affects immature and uncured wheat. "Wheat well into the 'dough' stage, if subjected to a temperature below freezing, may be *blistered* (frosted), but when 'in the milk' the same temperature produces *frozen* wheat." *Frozen wheat* "is badly shrunken, has lost the normal translucent amber color, is of an opaque, bronzed appearance, and has had the composition of its chemical constituents changed, as well as the internal structure of its cells destroyed." The grain contains less gluten, and the quality of the gluten is seemingly injured. It would seem that the albuminoid which gives tenacity to the flour is altered. Such wheat deteriorates greatly after being harvested. When used for seed the crop is deficient in protein and in gluten, and its gluten is of poor quality. Fermentation may set in later on and the chemical constituents be further changed, as was the case in Minnesota during the winter of 1888–89, so that the frozen wheat when planted in the spring was in a much worse condition than when

harvested the previous fall. In the majority of cases, however, the frozen seed germinated and produced wheat having the characteristics of the seed from which it sprung. "The results of this year seem to show that here we have an example of the transmission to the offspring of a characteristic developed in the parent by accidental outside influences. I have not attempted to establish this by the product from individual frozen grains, but wherever 1888 wheat containing frozen grains has been used for seed, there are so many grains in the crop similar in appearance and properties to these frozen grains, and without a repetition of the conditions which originally produced them, that it can be explained only in this way."

A number of instances are cited in which frozen, blistered, or rusted wheat of the crop of 1888 was used for seed in 1889 on farms in different parts of Minnesota and North Dakota. The condition of the seed used in each case is described, and analyses of the seed and in many cases of the crop of 1889 are reported. The desirability of cleaning the "poor wheat" to be used for seed is enforced by illustrations drawn from the actual experience of farmers. "Indeed, in many cases seed from very poor wheat when cleaned has yielded better than wheat originally good but uncleaned. The density of wheat must largely determine its value for seed." The importance of a change of seed every three or four years is also urged, though "in many cases it can not be clearly shown why a change of seed produces better results." In one instance cited, wheat from seed grown on the same farm for several generations—some of it frozen—gave relatively less protein and gluten and the gluten was of poor quality, while wheat from fresh, sound seed brought from outside, gave more protein and gluten and the gluten was of excellent quality. "Here, again, as everywhere that frozen wheat was planted, the difference between the crop from sound seed and the crop from frozen was not marked until after the wheat had been harvested."

From the cases above cited, and many others, I draw the following general conclusions:

(1) A vast difference as to their seed value exists between the various kinds of "poor wheat."

(2) Rusted and blistered (frosted) wheats, if well cleaned, are safe to use for seed.

(3) Frozen wheat which is utterly worthless for milling is likewise of no value for seed. It can not produce a good crop.

(4) The more thoroughly wheat is cleaned the better the seed resulting and the better the crop, particularly in yield. And by cleaning I mean besides separating the dirt, also casting out the weaker grains of wheat. Thus poor milling wheat may be made vastly better for seed than wheat of high milling value if the latter is uncleaned.

(5) Wheat should invariably be tested as regards its gluten and percentage of germination before being seeded. It seems absolutely necessary that the seed shall contain good gluten if the gluten is to be in the crop. * * *

To most successfully carry on the mechanical operations of milling it is first necessary to have plump wheat in which the hull has not been injured. Then the best flour, after the hull is gotten rid of, is made of that wheat which contains the most gluten and the least water. Other conditions of the wheat also enter as a factor.

To grow the best crops the first necessity is to have the germ of the wheat sound and then to have compactly stored up plenty of the proper kind of food—gluten, etc. Outside influences may cause the hull to be uneven or brittle without injuriously affecting the germ and its food; and this wrinkling of the hull may not be a property which will be transmitted by the seed to the crop, although in some cases it doubtless is. But certain changes in the character of the germ and its food are unmistakably transmitted. In blistered, rusted, and bleached wheats the superficial characteristics of the wheat are changed, while in frozen wheat changes seem to have been made in the reproductive faculties.

In any lot of wheat, even of the highest grade, some grains are vastly better than others for seed, and it is a simple matter to determine which they are and how to secure them. If it had not been clearly proven before, the last wheat crop has conclusively shown that the denser any grain of wheat the better it is for seed. These are the grains which are the heaviest for their size. If wheat is well cleaned by a blast of wind the lightest grains are cast out and the heaviest remain. In these the germ is best developed and protected and has most readily available the greatest amount of necessary food. Of this, gluten is of chief importance and its quantity and quality can be easily determined. For this I have given a method in Bulletin No. 7.

A continuation of investigations in this line is proposed. Farmers are requested to preserve samples of the seed as planted and of the resulting crop at harvest and after threshing. The station desires such samples for analysis.

Mississippi Station, Bulletin No. 11, February 15, 1890 (pp. 14).

CHARBON, G. C. CREELMAN, B. S. A.—This is a report of an investigation conducted by the author with the assistance of Dr. W. H. Wray, of the United States Department of Agriculture, and Dr. John W. Connoway, of the Missouri Agricultural Experiment Station. As previously stated in Bulletin No. 6 of this station (See Experiment Station Record, Vol. I, p. 101), the disease appeared first in Yazoo County, Mississippi, in June, 1889. It spread through the lowlands of the Delta, but was confined almost entirely to mules. Very few of the diseased animals recovered without treatment.

From replies to circulars sent out by the station it was learned that the first outbreak in this State of a disease supposed to be charbon was in 1836, at which time a malady prevailed known as "choking quinsy." Again in 1865 a few cases occurred, and in 1867 it was very prevalent. The winter previous had been very mild and was followed by an early spring. These conditions seem to be favorable for the development of the disease. Less marked epidemics prevailed in the years 1875, 1876, 1881, and 1882.

At first the disease was supposed not to be of a contagious nature, but from pathological investigations conducted at this Department and by Dr. Connoway, it was proved to be the true Anthrax, caused by the germ *Bacillus anthracis*.

Many planters in the Delta region have advanced the theory that the disease was caused by the swarms of flies which infest that locality, and have designated a particular species, which is very conspicuous

in every outbreak, as the "charbon fly." Upon investigation it was found that these flies attack the animals in such numbers as to leave on the back, belly, and legs a thick mass of clotted blood. As the germ of charbon was found in flies bloated with the blood of diseased mules, it was concluded that the flies are active agents in desseminating the disease.

Inoculation was practiced by Dr. Connoway on a large number of animals, but with what result the bulletin does not state. Some of the preventive measures advised are thorough disinfection of premises, painting the woodwork with a solution of carbolic acid to aid in keeping out the flies, giving the animals only well-water to drink, and the burning of all animals that die of the disease.

The following treatment was found very effectual:

"The moment the first symptoms are noticed the animal should be drenched with chlorate of potash 4 drams, tincture of the muriate of iron, 1 tablespoonful. Give in a pint of water, and repeat in three hours. Bathe the swellings with a mixture of one part carbolic acid to eight parts of water. * * * An abundance of good nutritious food, pure air, well-water, and protection from hot sun and rain are absolutely essential to success."

Missouri Station, Bulletin No. 11, May, 1890 (pp. **60**).

TEXAS FEVER, PAUL PAQUIN, M. D., V. S. (illustrated).—This is a report on investigations made between September, 1888, and March, 1890, by the author in co-operation with M. Francis, D. V. M., of the Texas Agricultural Experiment Station, and R. R. Dinwiddie, M. D., V. S., of the Arkansas Agricultural Experiment Station, who furnished some of the material and otherwise assisted in the work. The collection of specimens was begun in October, 1888, when soils, manures, ticks, urines, livers, spleens, kidneys, blood, bile, specimens from unborn calves, and fodders were obtained from various infected localities. These were carefully examined with a view to the discovery of a virus capable of producing Texas fever. Germs were found in all the specimens examined. Two important facts appear to have been brought out: first, that germs may be found in the normal liquids and tissues of infectious Southern cattle which appear healthy, and even in the young before birth, as well as in the manures, surface soils, waters, etc., of grounds where the fever originates; second, that this germ may be absent in dry fodder, well-water, spring water, and the subsoil in the infected district.

A 30-acre pasture in Boone County, Missouri, was secured and fitted up with suitable pens for the accommodation of cattle, in order to test the virulence of the Southern cattle-plague and study the development of the disease in Northern stock. From these experiments the following deductions were made: (1) that some of the germs found in Southern soils, waters, manures, etc., are identical with those found in cases of

Texas fever in Northern cattle; (2) that the germs of Texas fever are to be found in all Southern cattle coming from infectious grounds, and even in unborn calves; (3) that the average period of incubation in cattle exposed to the germs brought by Southern stock is about thirty days; (4) that cattle exposed to either manure or urine from Southern stock may contract Texas fever, and that inoculation from the pulp of the liver or spleen of such subjects may produce it; (5) that the germs must be taken into the body by the mouth or by inoculation, and that the disease is not conveyed by the breath of infected individuals; (6) that protective inoculation may render Northern cattle more capable of resisting the action of the Texas fever germ; (7) that sulphurated water is probably favorable to the modification or destruction of the germ of Texas fever.

Special experiments were tried to test the value of protective inoculation. Shipments of cattle, some of which were inoculated and others not, were made from Columbia, Missouri, to College Station, Texas, and to Helena, Arkansas. In the former case the total death rate among the inoculated stock was 20 per cent, while among stock not so protected it was 75 per cent; in the latter case the death rates were 75 per cent and 100 per cent, respectively. Protective inoculation was also successfully practiced upon a herd of native Missouri cattle that had been exposed to fever, and upon six native heifers at the Kansas City stock yards, which were afterwards exposed in the quarantine pens of these yards. In another instance where several herds of thoroughbred cattle were inoculated with the artificial virus and transported into the Indian Territory and Texas, this treatment proved an almost complete protection against the fever.

Regarding the germ of Texas fever the author concludes that it is susceptible of many changes during its vegetation, that the spherical, ovoid, and other forms which several observers have seen, represent different periods in the life cycle of the parasite, and that the microbe passes only a part of its existence in the animal body, and completes it in the outer world. The artificial cultivation of the germ is said to have presented many difficulties, but was at last successfully accomplished. It grew best in a mixture of artificial lymph and liver broth, and pure cultures were obtained from the liver, spleen, kidneys, etc., of infectious Southern cattle.

The germ was found in ticks bloated with the blood of infectious Southern cattle, and these ticks are supposed to be one of the media through which the germ is disseminated. The fact that Southern cattle transport the disease while they themselves remain free from its attacks is explained on the ground that they have been inoculated before birth. That affected natives do not readily give the disease to other natives is ascribed to the nature of the germs and to peculiar climatic conditions. When brought North in the bodies of Southern cattle and deposited with the manure and urine on pastures, the germs

are thought to remain inert for a month or two, but with the aid of sun heat and sufficient moisture they regain their virulence after a time and cause the death of susceptible cattle. When, however, these germs are deposited by affected Northern cattle before their virulence is regained, cold and frost modify and even destroy their activity.

Nevada Station, Bulletin No. 8, January, 1890 (pp. 14).

THE CODLING MOTH, F. H. HILLMAN, B. S. (illustrated).—An account of the life history of the codling moth (*Carpocapsa pomonella*) and the means for its repression. In an appendix, spraying apparatus is described and illustrated.

Nevada Station, Bulletin No. 9, May 31, 1890 (pp. 4).

A SERIOUS ROSE PEST, F. H. HILLMAN, B. S.—Notes on *Lithophana antennata* (Walker), with suggestions as to remedies.

New Jersey Stations, Bulletin No. 65, January 31, 1890 (pp. 15).

EXPERIMENTS WITH DIFFERENT BREEDS OF DAIRY COWS, M. E. GATES, PH. D. (pp. 3–15).—This is a continuation of the record of the experiments reported in Bulletins Nos. 57 and 61 of these stations (See Experiment Station Record, Vol. I, pp. 258 and 260). Five breeds—Ayrshire, Guernsey, Holstein-Friesian, Jersey, and Shorthorn—are included in the test. The bulletin contains monthly records of the food eaten and the yield of milk for November, December, and January, together with a tabular statement of the daily rations fed, the average daily yield per cow from August 1 to February 1, and the average quality of the milk as determined by chemical analysis. The food given during the summer and fall was believed by practical dairymen to conform closely, in kind and quantity, to that commonly used in milk dairies.

As stated in Bulletin No. 61, it was thought that the variations in and the poor quality of the green food supplied, due to the extreme moisture of the season, contributed largely to the variations observed in the quality of the milk.

The following analysis of the green fodder corn shows the variations which may have occurred in the rations supplied during August and September:

Month.	Dry matter.	Digestible nutrients in green material.		
		Fat.	Protein.	Carbohydrates.*
	Per cent	Per cent.	Per cent.	Per cent.
August 1	16.57	0.24	0.78	9.96
August 7	22.81	0.38	1.26	13.29
September 2	27.25	0.73	1.33	15.51

* Including fiber.

This table indicates that the corn fodder contained the minimum of solid matter on August 1, and that on September 1, 50 pounds of the corn fodder would have furnished almost the same quantity of food compounds as were contained in 100 pounds on the 1st of August.

A study of these analyses, in connection with a comparison of the other materials fed, indicated that there were wide variations in both the amount and proportion of food compounds supplied from month to month.

Early in December various forms of concentrated feeds were bought, a chemical analysis made of each, and a ration prepared which approximated closely in kind and quantity of food compounds, the standard daily ration for milch cows of 1,000 pounds live weight, viz., 0.40 pounds fat, 2.50 protein, and 12.50 carbohydrates. The ration for the cows of different weights varied in the total amount of food supplied by it, and not in the proportion of the food compounds to each other.

This ration was fed from December 15 till February 1, the superintendent making such deviations from the actual amounts indicated as in his judgment the varying condition of the individual cows might demand. * * * It was planned to have three samples of the milk of each herd each week, and such samples of milk from individual cows as might be deemed necessary.

The following table gives the average of the analyses of the milk of the five different breeds, for each month from August to January:

Month.	Ayrshire.		Guernsey.		Holstein-Friesian		Jersey		Shorthorn.	
	Total solids.	Fat.	Total solids	Fat.	Total solids.	Fat.	Total solids	Fat	Total solids.	Fat.
	P cent	*P. cent.*	*P. cent*	*P. cent*	*P. cent.*	*P cent*	*P cent.*	*P cent.*	*P. cent*	*P cent.*
August	11.76	.. ..	12 99	......	12 18	.. ....	13 37	.. ..	12 10	....
September	12 19	.. ...	13.56	....	12 45	.. ...	13 70	. ...	12.32	....
November	12 44	..	14.28	.. ...	12 27	.. ...	14 58	.. ...	12 95	... .
December	12.57	3 61	14 64	5.11	12.26	3.64	14.72	5 02	12.85	3 81
January	12.88	3 81	15 29	5 49	12.26	3 68	15.19	5.23	13.44	4.26

The tables given in the bulletin show "(1) that the large quantity of green fodder used under the conditions which existed the past season did not permit of a proper control of the actual food furnished; (2) that when conditions are such as to permit of a control of the rations, a decidedly favorable influence is exerted upon both the *quantity* and the *quality* of the product. It would seem, therefore, that when the quality of the milk is of importance, green fodder, which at best contains high percentages of moisture, should be used as a supplement to the ration rather than for the purpose of furnishing the bulk of the food. It is also shown that by a proper selection of materials and balancing of food compounds, the cost of the rations may be materially reduced, while at the same time the yield and quality of the product are improved."

As on December 1 thirteen of the cows had been giving milk for periods ranging from six to eight months, there was an increasing tendency for the quantity of milk to decrease as the time of calving approached. By substituting a ration consisting of 6 pounds of corn and oatmeal, 6 pounds of wheat bran, 5 pounds of timothy hay, 8 pounds of turnips, 5 pounds of shredded corn stalks, and 2 pounds of cotton-seed meal, the average yield of milk from December 15 to 31 was increased in three herds, and the quality of the product improved in every case over that of the first week of December.

New Jersey Stations, Bulletin No. 66, March 1, 1890 (pp. 8).

FERTILIZING MATERIALS, E. B. VOORHEES, M. A.—This includes the trade values of fertilizing ingredients for 1890, suggestions as to the economical purchase and rational use of nitrogen, phosphoric acid, and potash, formulas for mixtures of these ingredients for different crops, and suggestions regarding the home mixing of fertilizers.

It is not claimed that the buying of raw materials and mixing at home is the best and cheapest method of getting fertilizers under all conditions; however, the important points in favor of the method will bear repeating, viz.: (1) that a definite knowledge of the quality of the materials is secured; (2) that where farmers know what they want and unite in purchasing car lots, there is a decided saving in the cost of the plant food. * * *

It should be remembered in this connection that *nitrogen, phosphoric acid, and potash are necessary* for the full development of farm crops, and that the different crops have different capacities for using them; it is also true that when no increase in crop follows the proper application of any one or all of these elements, the crop has sources at command which provide sufficient quantities to develop it to that limit fixed by the existing conditions of climate and season.

In view of these facts, the *best fertilizer* resolves itself into the *best or most economical quantity of nitrogen, phosphoric acid, or potash to be used under the varying conditions of crop, soil, and season.* * * *

Individual farmers must determine for themselves whether for their land and their crops *single elements* may not be more profitable than any combination of two or more; the physical condition of the soil, and its previous cropping and manuring must also guide the farmer in deciding whether the amounts given in the table should be increased or diminished. As a broad, general rule, *greater immediate profits* are secured from *heavy dressings* on land in a high state of cultivation than on farms of average fertility.

New Jersey Stations, Bulletin No. 67, May 3, 1890 (pp. 3).

NOTE ON THE WHEAT LOUSE, J. B. SMITH.—Directions for the compounding and application of kerosene emulsion and fish-oil soap, published in view of indications that the wheat louse would prove a serious pest during the season of 1890.

North Carolina Station, Bulletin No. 70, April 15, 1890 (pp. 28).

THE WEED PESTS OF THE FARM, G. MCCARTHY, B. S. (pp. 3–23, illustrated).—The ways in which weeds work injury to the farmer are described, reasons why efforts should be made to exterminate them are given, and the need of a weed law in North Carolina is urged. The article also contains descriptions of twenty-three of the most troublesome varieties of weeds found in that State. These accounts are illustrated by cuts taken from the Reports of the United States Department of Agriculture, and other sources.

JAPAN CLOVER—ITS VALUE AS A RENOVATOR OF WORN SOILS, G. MCCARTHY, B. S. (pp. 24–27, illustrated).—Japan clover (*Lespedeza striata*) is described and illustrated, the conditions favorable to its growth are stated, and its usefulness as a renovator of worn-out soils,

through its ability to collect nitrogen from the air and soil, is urged. It is also recommended as affording excellent pasturage for animals, especially sheep. "In the spring of 1889 experimental plats of *Lespedeza* and all of the common clovers were sown on the North Carolina experiment farm. The soil was a very poor, stiff clay. The only fertilizer applied to the plats was a light dressing of phosphate at the time of sowing the seed. All the true clovers, lucern, and serradella did very poorly, but the plat of *Lespedeza* presented a most luxuriant appearance throughout the season. While all the other plats were more or less infested with crab grass and weeds, not a weed nor a blade of grass could be found in the *Lespedeza* plat."

North Carolina farmers are recommended to sow Japan clover in fields which are now unproductive, and by this means secure pasturage for sheep, and at the same time increase the fertility of the soil.

Ohio Station, Bulletin Vol. III, No. 3, March, 1890 (pp. 42).

EXPERIMENTS WITH CORN, J. F. HICKMAN, M. S. A. (pp. 75–96).—These include (1) test of varieties; (2) planting at different depths and dates; (3) distribution of seed; (4) planting of seed from different parts of the ear; (5) different amounts of cultivation; (6) deep *vs.* shallow cultivation; and (7) test of varieties of silage corn. The experiments were made on a fertile soil in a season which was rather dry, but not dry enough to prevent yields of from 60 to 90 bushels of corn per acre.

Corn, test of varieties (pp. 75–84).—The fifty-six varieties tested in 1889 are classified, according to the color of the grain and the size of the ear, into large yellow, medium yellow mixed, large white, and medium white dents; yellow, large white, and mixed or red flints; and soft or flour corn. The tabulated data for each variety include weight when husked, shrinkage in drying, weight of shelled corn, per cent of cob, color of cob, yield per acre of grain and fodder, date of cutting, number of days from planting to cutting, and state of maturity. Averages of yield, etc., are also given for the classes indicated above, and the relative yields of the different classes are shown in a diagram. Duplicate tests are reported for eight varieties. The differences between yields of the same variety on duplicate plats were generally less than the differences between the yields of different varieties.

Corn, planting at different depths and dates (pp. 84–88).—Tabulated results of planting at depths of 1, 2, 3, and 4 inches, and at intervals of ten days from April 26 to June 23, inclusive, for 1889, and for seven years (1883–89), together with the rain-fall and mean temperature at the station for the five months (April–August) of the corn season for seven years.

Corn, distribution of seed (p. 89).—Tabulated results of planting kernels from 6 to 72 inches apart and dropping from one to four grains at a time.

Corn, seed from different parts of the ear (pp. 90, 91).—The yield per

acre, and per cent of ears and nubbins from seed from the butt, middle, and tip of the ear, are recorded for 1886, 1888, and 1889. In 1889 the yields for each of the three parts of the ear were almost the same (77 bushels per acre).

Corn, different amounts of cultivation (pp. 91, 92).—The yields per acre, as calculated from the yields on plats where corn was cultivated from three to seven times, are given in tabular form and compared with the results of a similar experiment in 1888. "In the ordinary season of 1888 the lowest average yield was from the plats receiving the greatest amount of work," but in the dry season of 1889 the corresponding plats gave the highest average yield.

Corn, deep vs. shallow cultivation (p. 93).—The results of experiments with deep and shallow cultivation, as given in a table, favor the former method in 1889, as they did in a similar experiment in 1888.

Corn, test of varieties for silage (pp. 93, 94).—Tabulated notes are given for eleven varieties. Because of danger from frost the harvesting was done September 27, at which time only one variety, Early Sanford, had reached that stage of maturity which the author deems desirable.

What I mean by maturity in silage corn is that the stalk should be dry at the base, the lower leaves beginning to dry, and the grain fairly commenced to glaze. * * * Late planting has been generally advocated for silo purposes, but as experience accumulates I think we will all plant earlier, so that our corn will have more chance to mature. Our experience of last year I think will cause us to plant silage corn earlier this season, and also further apart; because, to make the best of silage, we must have more grain and riper fodder.

Corn, summary of experiments (pp. 95, 96).—

(1) Considering the several varieties of corn, according to our present classification, the large yellow dent varieties, as a class, are most productive. Large white dents take second place, followed by medium yellow dents, mixed dents, and medium white dents in the order named.

(2) In the flint varieties the large white flints take the lead, followed by mixed flints, and these by yellow flints.

(3) Taken as a whole or as individual varieties, the flint varieties are not a profitable class for Ohio land, unless it should be in some of the northern sections. The following are noted as failures at the station: Smut Nose, Top-Over, Hudson Bay, Angel of Midnight, Chadwick, Tuscarora, and King Philip.

(4) The soft or flour corns have failed to mature in the tests of the last two years. To grow them for stock-feeding purposes would not be profitable, and if they are valuable for house use their failure to mature prevents their general adoption in this latitude.

(5) Any of the large yellow dent varieties will give fair yields, but the ones more certain of maturing are the Leaming, Murdock's Improved, and Woodworth's. The Chester County Mammoth, Cloud's Early Dent, and Golden Beauty are quite uncertain, but when they mature they are fine varieties and good producers.

(6) Among the medium yellow dents the Clarage and Farmer's Favorite are recommended. Either of these is ten days earlier than any of the large yellow dents, and is probably better adapted to the more northern parts of the State.

(7) Of the large white dents Hess's White is a good variety for gravelly loam soils or other soils of a gravelly nature. The Champion Early Pearl has done fairly well this year and promises to be a good variety.

(8) In seven years' experiments with deep and shallow planting the average results show an advantage in favor of planting 1 inch rather than 2 inches deep, but indicate that in dry seasons it may be better to plant 2 inches deep.

(9) The greatest amount of marketable corn has been produced where the stalks averaged 12 inches apart; the variations in yield were slight, whether planted one grain every 12 inches, two every 24, three every 36, or four every 48 inches.

(10) Three years' trial has not indicated any marked differences in the reproductive qualities of corn from the butts, middles, or tips of the ears. If there is any variation it is in favor of middles and tips and against the butts.

(11) The experiments of 1888 and 1889 indicate that corn should be cultivated more frequently in a dry season than in a wet or ordinary one.

(12) The average results of two years' experiments favor deep cultivation rather than shallow. The implements used were the harrow and cultivator for shallow tillage and the double shovel for deep.

EXPERIMENTS WITH OATS, J. F. HICKMAN, M. S. A. (pp. 96–106).—

During the season of 1889 our work in oats was decreased rather than increased, the reduction being made because of lack of ground suitable for the purpose. The work of the year has included (1) a comparative test of varieties, and (2) experiments with different quantities of seed per acre.

The land used for the variety test of 1889 was not very suitable on account of its being rather rich for oats, but the light rain-fall during May, June, and July favored the crop; * * * and as a result the average yield of all the varieties, taken as a whole, was higher than in any previous year in the history of the station.

Oats, tests of varieties (pp. 96–104).—Tabulated data for fifty-five varieties are given, including yield per acre of grain and straw, weight of measured bushel, color of grain, and date of ripening. Improved American, from seed received from the United States Department of Agriculture, yielded 86 bushels per acre. Other varieties producing more than 80 bushels per acre were Monarch, Rust-Proof, Colonel, and Welch. The comparative yields and weights of measured bushels for each year are given for twenty-one varieties grown at the station from four to six years, and for two others grown two years.

In weight per measured bushel, the Welcome and Clydesdale remain above the average, but with the exception of one year (1888) they have not weighed the same per bushel since they were first raised at the station. The Badger Queen, Henderson's Clydesdale, Early Prize Cluster, White Victoria, Race Horse, and Barley oats average above 35 pounds per bushel for a series of years. It is a point worthy of notice that thirteen out of the twenty-three varieties do not average over 30.3 pounds per measured bushel, the Black Tartarian averaging the lowest, which is 28.8 pounds. Just one variety, the Black Russian, averages legal weight, while the average of the entire series (excepting the last two) is 32.8 pounds per bushel.

A study of the hundred and more varieties of oats grown at the station has impressed the author with the close resemblances existing between many varieties. Comparative tests of Welcome and Clydesdale oats in particular, during several years, have served to reveal the difficulty of distinguishing these as separate varieties. Brief reports are given of tests of ten varieties of oats by farmers in different parts of the State.

Oats, distribution of seed (pp. 104–106).—Seed was sown on eleven plats at the rate of from 2 to 12 pecks per acre. The results for 1889

are reported in one table, and in another are compared with those obtained in similar experiments in 1887 and 1888.

Oats, summary of experiments (p. 106).—

(1) In the comparative test the varieties giving the highest yield in 1889 were the Improved American, Monarch, Rust-Proof, Welch and Colonel. Kansas Hybrid, Probsteier and White Schoenen remain among the highest producers.

(2) Varieties weighing most to the measured bushel were Centennial, Early Prize Cluster, White Bonanza, Race Horse, White Victoria and Hargett's White.

(3) The highest percentage of oats standing at harvest was in the Hopetown, Welch, Wideawake, Improved American, and Rust-Proof.

(4) The varieties giving the highest average yield in a series of years are the White Schoenen, Monarch, Probsteier, Early Dakota and Rust-Proof. These have averaged 60 bushels and above. Some of them four years, some five and some six.

(5) Seeding at the rate of 5, 6, 7, and 8 pecks per acre in 1889 gave yields almost identical. Seeding at less than 5 and more than 8 pecks gave smaller yields. In the average of two seasons' experiments a larger yield has been obtained from sowing at the rate of 6 pecks than from a larger or smaller quantity of seed.

ACTINOMYCOSIS, H. J. DETMERS, M. V. D. (pp. 107–116).—A popular account of the history and nature of this disease, of the fungus causing it, of the lesions which it produces, and of the methods of treatment. The following summary by the director of the station is appended to the article,

Actinomycosis—"big jaw" or "lump jaw" of cattle, "big head" of horses—is caused by a parasitic fungus, which grows within the bony or fleshy tissues, and is generally found in the jaw, but sometimes in the tongue, in the lungs, and in other parts of the body.

This fungus propagates by "spores," corresponding to the seeds of higher plants, which are widely disseminated and which find an entrance to the animal through wounds or abrasions of the skin or internal membranes, through the temporary exposures of the tissues in shedding teeth, etc.

When suitably lodged in the animal these spores produce nests of fungi, which may be distinguished by the unaided eye as minute yellowish specks, but which appear under the microscope to be round or oval in shape, and to be distinctly radiated from center to circumference.

The disease produced by this fungus is purely local in its character, affecting only the tissues in which it is immediately situated, and the final emaciation and decline of animals affected with it are due solely to the inability of the affected animal to masticate sufficient food to keep up its condition.

The cure for actinomycos is is either tocut out or to destroy with caustics the disease-producing fungus. If the diseased growth has penetrated the bones, or is so located that neither of these methods can be employed without interfering with important blood vessels or other organs, no cure can be effected; but if it be a simple sarcomatous (fleshy) tumor, and so situated that the surgeon's knife may be safely used, a cure may be effected by the complete removal of the tumor, followed by antiseptic treatment. In many cases where it is not practicable to use the knife the diseased growth may be removed by the thorough use of caustics, minute directions for which are given.

Ohio Station, Bulletin Vol. III, No. 4, April, 1890 (pp. 37).

SPRAYING TO PREVENT INSECT INJURY, C. M. WEED, M. S. (pp. 119–127).—Various kinds of spraying apparatus are described and illustrated, and accounts are given of the preparation of insecticides, their principal uses, and the methods of their action.

BARK-LICE OF THE APPLE AND PEAR, C. M. WEED, M. S. (pp. 127–129, illustrated).—Brief notes on the oyster-shell bark-louse (*Mytilaspis pomorum*) and the scurfy bark-louse (*Chionaspis furfurus*), with suggestions as to remedies.

BUFFALO TREE-HOPPER, C. M. WEED, M. S. (pp. 130–132, illustrated).—Notes on the buffalo tree-hopper (*Ceresa bubalus*), injuries by which in Ohio were reported to the station.

INSECTS AFFECTING CORN IN SOUTHERN OHIO, C. M. WEED, M. S. (pp. 133–136, illustrated).—Notes on the white grub, twelve-spotted cucumber beetle (*Diabrotica 12-punctata*), and corn-root louse.

OX-WARBLE FLY OR BOT FLY, C. M. WEED, M. S. (pp. 136–139, illustrated).—Notes on the ox-warble or bot fly (*Hypoderma bovis*), with suggestions as to remedies.

FUNGOUS DISEASES OF PLANTS AND THEIR REMEDIES, C. M. WEED, M. S. (pp. 139–144).—General explanations of fungous diseases and directions for the preparation and use of various fungicides.

DIRECTIONS FOR COLLECTING, PRESERVING, AND STUDYING PLANTS, FREDA DETMERS, B. S. (pp. 144–151).

South Carolina Station, Bulletin No. 8 (New Series), March, 1890 (pp. 27).

CHEMICAL COMPOSITION OF CORN, SILAGE, COW-PEAS, AND SOJA BEANS IN SOUTH CAROLINA, J. B. MCBRYDE, C. E. (pp. 55–79).—In view of the fact that few, if any, analyses of corn and forage crops grown in South Carolina had been made, the investigations reported in this bulletin were undertaken. The samples analyzed were from crops grown on the farms of the experiment station and from corn grown for the prize recently offered by the *American Agriculturist.*

Corn.—The tabulated data of the analyses include the composition and the fertilizing constituents of the grain, cob, and shuck; the average composition of the grain, cob, and shuck of corn grown at the experiment farms; and per cents of grain and cob, and of moisture in corn grown for the prize. In other tables the results of similar analyses of Western and Northern corn made at the stations in Connecticut and Massachusetts are compared with those of the corn grown in South Carolina. The weights of different parts of the corn plant expressed in per cents are also given as found in experiments in Missouri, Connecticut, and South Carolina. Conclusions are drawn as follows: "(1) that in an average crop of Indian corn the ear is by weight approximately one half the entire crop; (2) that about four fifths of the ear is grain; (3) that about one half of the stover is stalk." Attention is called to the desirability of feeding the entire plant instead of throwing away the stover, as is commonly done in that section.

More than 20 per cent of the crude protein and 50 per cent of the carbohydrates are contained in this much neglected portion of the crop. Such waste of valuable constituents is not an inconsiderable matter, but one which would certainly seem to warrant the trial of some judicious system of feeding whereby it might be avoided. The grain and cob should be ground together, and the entire stover run through a

cutting or shredding machine, as at the North, where both systems are practiced with much success. * * * By feeding the fodder only a very small waste of fertilizing constituents need be incurred, as the manure on a well-regulated farm should always be returned to the land. Some further statistics of this crop will be found under the discussion of cow-pea vines.

Corn-fodder silage.—Results of analyses of three samples, one from each of the experiment farms of the station, are reported.

Cow-peas, oats, and corn.—

The cow-pea seems especially adapted to meet the wants of our Southern farmers. Its extensive and deep root system enables it to withstand the long dry spells common to our climate, and also to gather nourishment from soils on which shallow-growing crops would starve. It responds readily to fertilizers, and on fair soils will produce as large a yield of nutritive matter as almost any forage crop we can grow. It makes such a rapid growth that two crops can be grown in a season. The growth is so luxuriant that all noxious weeds are choked out. The most serious objections urged against this crop are its great bulk and the difficulty of curing it. It is not, however, more difficult to cure than clover, and, properly managed, makes an excellent long forage.

The tabulated data include the composition and fertilizing constituents of cow-pea-vine hay; fertilizing constituents in cow-pea vines, roots, and stubble; and for cow-pea vines, oats, and corn, average composition and yield of crude nutrients in the whole and parts of the plants; yield of digestible matter in the whole crop; yield of fertilizing constituents in the whole and parts of the crop. The following conclusions were drawn from these analyses:

(1) For the production of a nitrogenous food, in the shape of a forage crop, the cow-pea vines are almost without a rival.

(2) Although no digestion experiments have as yet been made with it, there is every reason to believe that this crop is equally as digestible as leguminous plants in general.

(3) On an acre of ordinary land this crop will probably produce more digestible food than either oats or corn.

(4) The manure resulting from feeding this crop is of the highest value, and should be carefully preserved and returned to the land.

(5) As the cow-pea obtains a part of its nitrogen from the atmosphere, and a part, together with some of its phosphoric acid and potash, from the subsoil, the large amount of these constituents left in its roots and stubble and dead leaves dropped by the plant tend to enrich instead of impoverish the soil. In other words, its power of collecting and storing fertilizing materials from sources beyond the reach of the cereals makes this cow-pea a valuable remedial crop. In addition to all this, it is more than probable that the shade produced by the luxuriant growth of this crop during the summer months, when nitrification is most active, greatly promotes the formation and storage of nitrates in the soil.

Cow-peas, soja beans, and soja-bean vines.—The tabulated data include the composition of cow-peas and soja beans (seeds), fertilizing constituents in cow-peas, and the composition and fertilizing constituents of soja-bean vines and straw.

South Dakota Station, Bulletin No. 18, March, 1890 (pp. 8).

CUT-WORMS, I. H. ORCUTT, M. D., and J. M. ALDRICH, B. S. (pp. 31–36).—Brief notes on cut-worms, suggestions as to means for their

repression, and a short summary of replies to a circular of inquiry sent out by the station to farmers in different parts of the State with reference to injuries by these insects. The chief damage reported was to corn. The replies seem to indicate that corn is very liable to the depredations of cut-worms when it follows wheat, and especially oats, and is less so after millet.

Tennessee Station, Bulletin Vol. III, No. 2, April, 1890 (pp. 16).

FIELD EXPERIMENTS WITH BARLEY, CORN, OATS, WHEAT, SORGHUM, AND CLOVER, C. S. PLUMB, B. S.

Barley, test of varieties (p. 3).—Tabulated notes on five varieties. Mansbury gave the best results. Scotch Chevalier, the only two-rowed variety tested, is recommended as "a strong, robust, productive variety, and especially exempt from disease. It rarely lodges, and produces a large seed."

Corn, test of varieties (pp. 3–7).—Tabulated notes on thirty-eight varieties of dents, thirteen of flints, and fifty-four of sweet-corn.

The following varieties are recommended for this region for productiveness, quality, and vigor of growth:

Dents.—Adams's Early, Golden Beauty, Maryland White Gourd Seed. Shannon's Big Tennessee White, and Southern Horse Tooth. Adams's Early is probably the best variety for table use, as its ears are not large, and it is suitable for eating earlier than most corn.

Flints.—Compton's Early, King Philip, Sanford, and White Flint Thoroughbred. However, we do not especially recommend flint corn for Tennessee. The yield of fodder is very small, and the corn is not nearly so productive as the dents.

Sweets.—We do not feel disposed to recommend any of these sweet varieties for this region, as they have been a failure, almost completely, for two reasons: first, the corn-worm has infested the ears so badly as to make them unfit for eating; second, this class of corn develops very poorly here. Varieties of sweet-corn that make vigorous, robust growth in the North have with us been small and spindling—almost dwarfs. The climatic conditions are evidently not favorable to successful culture of most sweet varieties.

Oats, test of varieties (pp. 7–11).—Tabulated notes on forty-three varieties, with descriptive notes on thirty of these varieties. "Early Ewing was the first to mature, being ripe on June 26. Next earliest were the several rust-proof varieties. * * * For this locality the rust-proof varieties are best, as they ripen early, have strong straw, and are not so badly affected with rust as are other varieties of a large, coarse character." Black Tartarian, Clydesdale (synonyms: Welcome, Centennial, White Australian, White Wonder), Probsteier, Winter Grazing, and Winter Turf are especially recommended.

Oats, experiment with fertilizers (p. 11).—Muriate of potash, cotton-seed meal, nitrate of soda, acid phosphate, and kainit, singly, and the last three in combination, were compared with each other and with no manure, for Kansas Rust-Proof oats on 12 twentieth-acre plats, on light, clayey loam. The highest yields were with muriate of potash and kainit, and the average yield of 3 plats where potash was used was higher than any of the yields from other forms of fertilizers. The smallest yields

were with no manure, and with nitrate of soda, acid phosphate, and kainit combined.

Wheat, test of varieties (pp. 11–13).—Tabulated notes on thirty-six varieties, tested on ninetieth-acre plats, on clay-loam soil, which was "rather poor." The best results were with Tasmanian Red, Nigger, New Golden, German Emperor, and Michigan Amber.

From several years' experience with Tasmanian Red and Nigger we can especially recommend them for this locality. Both are bearded varieties, very hardy and productive. Nigger wheat is especially adapted to this region, having originated in Kentucky, so far as is known. Diehl-Mediterranean, Mediterranean Hybrid, and Michigan Bronze are the same variety under different names. It is well worth a trial.

Fulcaster, one of the newer varieties, while not doing well with us in this test, can nevertheless be recommended for hardiness and strong growth. As a rule, it is a good yielder compared with other varieties.

Wheat, methods of culture (pp. 13, 14).—Four methods, (1) planting in rows by hand and cultivating with the hoe; (2) sowing in drills, with no cultivation; (3) sowing in drills with mulching; and (4) sowing broadcast, with harrowing, were compared on 8 fourth-acre plats. The results are stated in a table. The average yield per acre of the two plats in each class was as follows: hoed plats, 12 bushels; drilled plats, 19½ bushels; mulched plats, 18½ bushels; harrowed plats, 16½ bushels.

Sorghum, test of varieties (pp. 14, 15).—Tabulated notes on forty-four varieties. The following varieties were the earliest to ripen, and were fit to cut at about the same time, September 3: Chinese, Georgia, No. 5, No. 30, Sorghum Saccharatum, White Amber, Dutchess Hybrid, Kansas Red, No. 18, Price's New Hybrid, Waubansee, Whiting's Early. A change of chemist at the station prevented the making of sugar determinations, as was intended.

Clover, experiment with fertilizers (pp. 15, 16).—Various fertilizers (nearly the same as those used in the experiment with oats above referred to) were applied to 8 half-acre plats of light clay-loam land which had been in red clover for two years, and the results compared with those from two unfertilized plats. The amounts of fertilizers and the yield of the first and second crops are given in a table. Rains seriously affected the curing of the present crop.

If we were to accept the results in this table as bearing on the first crop, we should see that:

(1) The largest yield comes from unfertilized land.

(2) The next largest yield comes from a mixture of two thirds phosphate and one third potash.

(3) The third best results come from cotton-seed meal.

However, experience teaches us two things:

(1) That unfertililized lands give us the poorest returns.

(2) That the cotton-seed meal could not have been much used as a plant food by the first growth, as the plants were already too advanced in growth to have felt the effects of the decomposition of the meal.

This is a good example of the general uncertainty of the results of plat tests. Such experiments, to have a significant value, should be permanent, extending over many years, under as nearly identical conditions as possible.

Tennessee Station, Special Bulletin C, May 10, 1890 (pp. 8).

THE TREATMENT OF CERTAIN FUNGOUS DISEASES OF PLANTS, F. L. SCRIBNER, B. S.—Practical directions for the treatment of black rot of grapes, apple scab, downy mildew of the vine, brown rot of grapes, powdery mildews, leaf brownness of the pear and quince, potato rot, and smuts of oats and wheat.

Texas Station, Bulletin No. 9, May, 1890 (pp. 29).

PEAR STOCKS, T. L. BRUNK, B. S. (pp. 5–22, illustrated).—Authorities are cited with reference to the best stock on which to graft or bud the pear and their conclusions summed up in the statements that "(1) there must be a close affinity between stock and scion for long life and health of a tree; (2) stocks through high culture and bad selection of seeds become deteriorated and unfit for use; (3) stocks should be adapted to the climate and soil in which the trees are grown; (4) many of our best varieties of pears have been so reduced in constitutional vigor by working them through a series of generations on weak and poor stocks that they have become almost worthless and subject to the inroads of disease; (5) the present weakened and short-lived pear-tree is the result of man's neglect and misuse of nature's laws and powers."
This being a question of great importance to the Southern nurserymen and fruit growers, investigations in this line were instituted by the author. Orchards in various parts of the States were visited, letters of inquiry were sent out, and "during the past winter all the stocks on which pears are 'worked' as standards were procured and placed in the experimental grounds, and on them were worked the Le Conte and Keiffer and several other pears. The stocks include the Le Conte and Keiffer grown from cuttings from 'pedigree' trees, French seedling pears, Mikado pear seedlings, and apple seedlings. The grafts were made so as to force the scion in every case to grow on the roots of the stock only." By means of these experiments the author hopes that further light will be thrown on this matter. The present bulletin is only a report of the observations made by the author during the visits above referred to and of the replies received to the letters of inquiry.

The question of first importance is "to decide which is the best stock for the Le Conte and Keiffer pear trees, the Oriental (*i. e.* the Le Conte or Keiffer on their own roots) or the French pear seedling * * *

The claims of the friends of the French pear seedling or well-grown American pear seedlings from European pear seed as a stock for the Le Conte and Keiffer pear trees are as follows:

(1) The trees make fully as good growths as those grown on their own roots; (2) come into bearing one or two years sooner; (3) are fully as prolific or more so; (4) do not sucker or sprout from the roots any more than other fruits on seedling stocks of the same species; (5) are less subject to blight; (6) the affinity between Oriental pears and the French stock is close, but the Oriental pear being a more vigorous grower than the American or European pears, they influence the stock to the extent of forming enlargements, which do no harm.

The friends of the "pedigree" Le Conte and Keiffer stock for these two pears claim:

(1) That these pears on their own roots make a far better and more uniform growth than those on French stock; (2) that while they do not always come into bearing quite as soon as a rule as those on the French stock, yet when they do begin to bear they produce more per tree, and continue to increase year after year, while those on French stock die early and do not bear uniformly, some bearing profitable crops and others none; (3) that those on their own roots never sucker from the roots, while the sprouts from the roots of the French stock are so numerous and persistent that they become a great nuisance to the cultivator, necessitating high pruning to get at them; (4) that those on French stock are more subject to disease than those on their own roots; (5) that the affinity of the French stock for the Oriental pear is not close, as the stock becomes much enlarged below the place of graft, and also throws out excresences of abnormal tissue near the top of the stock.

The author visited a number of orchards in North, Central, and Southern Texas and examined the roots (often over three feet below the surface) of grafted and ungrafted trees, removed some entirely from the soil, split open the trunk and found the original graft, noted the comparative growth between trees of the same age and under the same treatment, and made a few sketches of specimens showing the exact conditions of stock and scion after several years' growth.

The important facts gathered from these observations were: (1) That where the Le Conte or Keiffer was grafted upon the French stock or apple stock, and was set deep enough, the scion invariably threw out its own roots, and that the scion made an effort proportionate to its strength and hold upon the soil to throw off the stock, and in several cases had succeeded in doing it. * * * This tendency has led some to the erroneous belief that the Le Conte grows as well on the French stock as on its roots. * * *

(2) That where the Le Conte and Keiffer and other varieties were planted so shallow that they were forced to grow upon the French or apple stock, the stock outgrew the scion in every case, forming an ugly enlargement from the point of graft downward, and in all cases they threw up sprouts. These sprouts make it difficult to cultivate an orchard, as an incessant amount of labor is necessary to keep them down, and it requires high pruning of the limbs that they may be reached. * * *

(3) That grafted trees forced to grow only on the French stock were far less vigorous and less uniform in their growth than those on their own roots. Some of the grafted trees are more than double the size of other grafted ones, while those on their own roots are symmetrical and uniform to a high degree. As to time of coming into bearing and prolificness of grafted and ungrafted Le Conte and Keiffer trees, there is no doubt that the grafted tree bears younger in most localities, but it never bears as heavily as the tree on its own roots. The time when the Le Conte on its own roots begins to bear varies with the conditions of soil, latitude, and culture. * * *

The author is confident that the Le Conte thrives best in every respect in a strip of territory not over a hundred miles wide and lying next to the Gulf from Texas to Florida, inclusive. Also that it must be grown on well-drained lands, and best on a heavy clay subsoil with a shallow soil above.

As to the Le Conte or Keiffer being more subject to diseases on a particular stock, I will say that it depends on soil, latitude, and culture. As already shown, the Le Conte and Keiffer are far less subject to blight on well-drained soils in the Gulf region on their own roots than on the French stock. * * *

In all of my correspondence only three recommend the use of the French stock for the Le Conte and Keiffer pears, while many, without solicitation on my part, stated that they believed the Le Conte to be the best stock for European pears.

Reference is made to successful experiments by Mr. W. Jennings, of Thomasville, Georgia, in improving European varieties of pears by

grafting them on Le Conte stock. Experiments in a similar line are in progress at the station.

As to the use of the apple seedling for a pear stock, my observations confirm the idea that they are even worse than the French pear seedling to sucker, and the trees are short-lived. But as apple seedlings are plentiful and cheap it may be a good plan, on soils where the Le Conte and Keiffer do not root easily, or a profitable percentage of the cuttings do not grow, to use them or pieces of them to side graft on Le Conte cuttings as a nurse to aid in keeping the cutting alive till it forms its own roots. In the fall, when the trees are removed from the nursery, the apple root can be removed and the tree left on its own roots.

The bulletin also contains cuts illustrating the condition of stock and scion in the case of a number of specimens of grafts observed by the author in different parts of Texas, and extracts from letters received from Texas and other Southern States in reply to the circular of inquiry sent out from the station.

SOME PARASITIC FUNGI OF TEXAS, H. S. JENNINGS (pp. 23–29).—Brief descriptive notes on ninety-five species of fungi.

Texas Station, Bulletin No. 10, May, 1890 (pp. 31).

FEEDING EXPERIMENT, F. A. GULLEY, M. S., AND J. W. CARSON.—The general improvement of the cattle business of the country, the fact that cattle-slaughtering plants are soon to be in operation in this State, and the superior advantages of Texas for breeding cattle are stated to be considerations which make the question whether they can be grown and fed successfully in the State, instead of being taken elsewhere for this purpose, one of the greatest importance. In the feeding experiments begun at this station in 1889 an attempt has been made to show that cattle may be fattened as successfully and at as low cost in Texas as in any part of the country. The first report of these experiments was made in Bulletin No. 6, of the station (See Experiment Station Record, Vol. I, p. 152). The questions propounded in the experiments there reported were:

(1) Is it profitable and practicable to shelter range cattle in feeding? (2) What feeding stuffs, that can be supplied in the State, give the best returns for cost? (3) Can the native Texas steer be fed profitably?

Fifty-five head of native cattle were fed on different rations, made up of corn, hay, cotton seed raw and cooked, cotton-seed hulls, cotton-seed meal, and silage. The results showed that range steers may be dehorned and fed loose under a shed, crowded together like sheep, successfully, and that cost of certain food consumed is much less than increased value of steers from gains made in weight at selling prices of food and steers.

In the present bulletin experiments made in the winter of 1889–90 are described.

The two leading questions were: (1) What is the best to feed with cotton hulls? (2) What is the best to feed with silage? Incidental questions were: (1) Will sweetening the ration make it more palatable to cattle? (2) Is corn silage a better cattle food than dry corn-fodder? (3) What is the comparative value of cotton seed and cotton-seed meal for feeding? (4) Is corn the best grain to feed with corn silage? (5) Will changing the ration stimulate the appetite and cause

cattle to fatten more rapidly? (6) Will hogs do as well running after silage and cotton-seed meal-fed cattle as after hay, corn, and cotton-seed-fed cattle? (7) Will cotton seed improve the corn and hay ration? (8) Are cotton hulls with cotton-seed meal a good food to fatten sheep?

This feeding experiment was planned with special reference to testing the principal available feeding stuffs of the State under conditions as nearly alike as it is practicable to secure where profit is taken into account. The steers used in the experiment were divided into two lots. Lot 1 consisted of fifty steers, arranged in eleven pens containing from three to eight animals each, and fed ninety days. Lot 2 consisted of twenty-two steers, arranged in three pens containing from three to ten animals each, and fed seventy-nine days. Different rations were fed to the different pens. For pens 1 to 6 of lot 1, silage was used as the basis of the ration, to which corn-fodder, hay, boiled cotton seed, cotton-seed meal, and corn-and-cob meal were added in different mixtures. For pens 7 to 11 of lot 1, cotton seed hulls were the basis of the ration, to which hay, silage, cotton-seed meal, corn-and-cob meal, and molasses were added in different mixtures and amounts. For lot 2 silage, hay, cotton-seed hulls, cotton-seed meal, cotton seed (raw and cooked), and corn in the ear were used in different mixtures.

"The effect of greater freedom, change, and variety of food is shown in the rapid increase, even after the cattle had been fed seventy-nine and ninety days, and made an average gain of over 200 pounds per head." Artificial conditions, which to some extent are unavoidable in such experiments, prevented the attainment of the best results as regards increase in weight. Among such conditions are the confinement of cattle in small pens, the use of the same feeding stuffs without change during the entire period of feeding, and the frequent weighing of the cattle.

Details of the average amount of food consumed per day for each period of ten days, live weight, etc., are given in nineteen tables, which are summarized in two additional tables. There are also accompanying explanations, together with discussions of questions as to feeding stuffs used individually and in mixtures. Minor experiments in feeding hogs along with cattle fed on cotton seed and in the use of cotton-seed hulls for sheep, are cited.

Among the general statements in the bulletin are the following: If one half of the annual crop of cotton seed produced in the State is converted into oil, meal, and hulls at the oil-mills, the yearly output of cotton-seed hulls will be approximately 200,000 tons, which, with cotton-seed meal and other concentrated feeding stuffs, will fatten 200,000 head of cattle, if the results obtained from feeding experiments at the station and at oil-mills are correct. The use of the hulls for feeding will increase the value of cotton seed, make a home market for range cattle, and thus benefit both cotton planter and cattle raiser.

Land that will produce 30 to 35 bushels of corn to the acre, will make 15 tons of silage from either corn or sorghum. Sorghum thrives in any place in Texas where

any farm crop will grow, and on the light soils and in dry years it yields more to the acre than corn; 20 to 25 tons is not an unusual yield on the best lands. Estimating man and horse labor at $1 per day each, the crop for silage, either corn or sorghum, may be grown, cut down, run through the cutter, and stored in the silo ready to feed at a total cost of less than $1.50 per ton. * * * For the reasons set forth we have paid especial attention to silage and cotton hulls in our feeding experiments, and from the foregoing it will be observed that we have in cotton hulls, for cattle feeders in the vicinity of oil-mills, cheap, rough fodder for feeding a large number of cattle; and by growing silage we can produce cheap feed in almost any part of the State, and in unlimited quantity, which, in addition to our corn, hay, and other forage crops, should enable us to fatten all cattle before they are slaughtered or leave the State.

In three of the pens molasses was added to cotton-seed hulls and meal, to make the ration more palatable. "The molasses was diluted with three parts of water to one of molasses, and sprinkled over the food at the rate of one half pint of molasses per head per day." In another pen molasses was used with silage. The conclusion from this experiment was that "cheap molasses may be profitably added to cotton hulls and cotton-seed meal, but not to silage, which is already sweet or has an acid flavor which makes it palatable to the animal."

Though the corn fodder used was cured and stored under the best conditions, only 47 per cent of that placed in the manger was consumed, while 91.8 per cent of the silage fed to pen 3, during the same period, was consumed.

Our two experiments seem to show quite conclusively that cotton seed, at $7 per ton, is a much cheaper feeding stuff than cotton-seed meal, at $20, if calculated on cost of food per pound gain made by steers; but, on the other hand, steers fed on cotton-seed meal gain so much more when fed eighty to ninety days, that the extra cost is partially made up in increased value of the steers due to better condition. * * *

Conclusions.—The experiments for the two winters show that (1) of our different cattle foods, a ration made up of cotton hulls and cotton-seed meal is equal, if not superior, to a ration of any other two feeding stuffs used for fattening cattle, but a cheaper ration may be compounded of silage and cotton seed, or of corn, hay, and cotton seed, at the prices given. *

(2) The addition of some other feeding stuff to the cotton hull and cotton-seed meal ration makes it more palatable to cattle, and produces better results in gain in weight. Corn meal, hay, silage, and molasses, each one added to cotton hulls and cotton-seed meal, made larger gains than hulls and meal alone, in the order named, molasses giving the best result.

(3) Of the several rations containing silage, silage with cotton hulls, and cotton-seed meal gave the best gains; silage with cotton-seed meal came second; silage with boiled cotton seed third; silage with corn-and-cob meal, and cotton seed meal fourth; silage with corn-and-cob meal fifth. Dry corn fodder did not give as large gain as silage. Molasses did not improve the ration containing silage.

(4) Cotton hulls and cotton-seed meal, with hay, corn, silage, and molasses, gave larger gains than silage and cotton-seed meal, or silage and cotton seed.

(5) Cotton-seed meal, with other feeding stuffs and fodders, gave larger gains than cotton seed with other feeding stuffs and fodders.

(6) Cotton seed, with other feeding stuffs and fodders, made gains at less cost for food than cotton-seed meal with other feeding stuffs and fodders.

(7) After feeding any of the rations used without change for sixty days, the daily gain diminished, until finally, in some pens, it ceased entirely; but with a change of ration, the daily gain in all of the pens was largely increased, in some pens exceeding the average of the first period of feeding.

(8) Corn and hay alone are more costly, and will not fatten cattle as rapidly as rations containing cotton seed and cotton-seed meal with cotton hulls or silage; and boiled cotton seed added to the corn and hay ration makes more rapid gain than corn and hay alone, and at considerable less cost per pound for food consumed.

(9) The waste from cattle fed hay, corn, silage, and raw cotton seed was worth considerable more for hogs running after the steers than the waste from cattle fed silage, cotton hulls, and cotton-seed meal.

The bulletin also contains a letter of inquiry regarding the cost of fattening cattle, which was sent to persons interested in cattle raising in Texas and elsewhere. Replies are given from R. L. Maupin, of Mobile, Alabama, and from the experiment stations in Colorado, Wisconsin, Michigan, Illinois, Iowa, and Colorado.

Vermont Station, Bulletin No. 19, April, 1890 (pp. 4).

QUESTIONS CONCERNING INJURIOUS INSECTS, G. H. PERKINS, PH. D.—A list of questions sent farmers of Vermont, with a view to securing information on which to base the work of the station in entomology for the season of 1890.

Vermont Station, Bulletin No. 20, May, 1890 (pp. 15).

FERTILIZER ANALYSIS, W. W. COOKE, M. A. (pp. 27-39).—This contains the trade values of fertilizing ingredients in raw materials and chemicals for 1890, as agreed upon by the stations of Massachusetts, Connecticut and New Jersey; explanations of these values; and analyses of thirty-one brands of commercial fertilizers. A comparison of the average composition of sixteen standard brands of fertilizers analyzed in 1889 with that of the same brands analyzed in 1890 shows—

That the quality of the fertilizers sold has changed quite decidedly during the past year. Notwithstanding the fact that the price of materials furnishing nitrogen has decreased so that the valuation has been lowered from 19 cents a pound to 17 cents, yet fertilizer manufacturers have decreased the amount of nitrogen in their goods by 68 cents per ton. At the same time, though there has been no change in the price of materials containing phosphoric acid, the amount of it in the fertilizers has dropped $1.20. Potash has remained the same in price and amount. On the whole, therefore, these sixteen brands of fertilizers, which constitute the great bulk of all the fertilizers sold in the State, have a valuation this year of $1.84 less than last, when calculated on the same prices. But since the selling price in Vermont averages about 25 per cent above the valuation, it follows that this amount should be added to the difference in valuation to get the real difference in commercial value, and this gives $2.30. That is, in order that the farmer may get the same return for his money, he should purchase his fertilizers for $2.30 per ton cheaper than he did last year. There has been no fall in retail price corresponding to this decrease in quality. The decrease in price on these sixteen brands has been 88 cents. This means, then, that while the cost of the raw materials to the manufacturers has decreased, yet these manufacturers have so lowered the quality of their goods as to make the farmer pay about $1.50 more per ton than last year for the same amount of plant food. This amounts to $6,000 on the fertilizer business of this State.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF

DIVISION OF ENTOMOLOGY.

INSECT LIFE, VOL. III, NO. 1, AUGUST, 1890 (pp. 1–41).—The princpal articles are those on a peach pest (*Ceratitis capitata*, Wied.) in Bermuda; the canker-worm, by C. W. Hargitt; *Monostegia ignota* (Norton), by F. W. Mally; larvæ of a crane fly destroying young wheat in Indiana, by F. M. Webster; some of the bred parasitic *Hymenoptera* in the National Collection (continued from Volume II); and how are insect vivaria to be lighted? by A. H. Swinton. The index and table of contents for Volume II are also sent out with this number.

DIVISION OF ORNITHOLOGY AND MAMMALOGY.

NORTH AMERICAN FAUNA No. 3 (pp. 136).

RESULTS OF A BIOLOGICAL SURVEY OF THE SAN FRANCISCO MOUNTAIN REGION AND DESERT OF THE LITTLE COLORADO, ARIZONA, C. HART MERRIAM AND LEONHARD STEJNEGER (illustrated).—The survey was made during August and September, 1889. "The present paper consists of five parts: (1) an announcement of the general results of the survey, with special reference to the geographic and vertical distribution of species; (2) results of a brief visit to the Grand Cañon of the Colorado; (3) an annotated list of the mammals of the San Francisco Mountain region, including the desert of the Little Colorado, with descriptions of new species; (4) an annotated list of the birds; (5) an annotated list of the reptiles and batrachians, with descriptions of new species."

The first four parts are by Dr. Merriam and the fifth by Dr. Stejneger, curator of reptiles in the U. S. National Museum. The bulletin is illustrated with five colored maps, among which are a map of Arizona, showing the life areas of the Colorado Plateau; a biological map of the San Francisco Mountain region, Arizona, showing the seven life zones defined by the survey; and a provisional biological map of North America, showing the principal life areas. There are also thirteen

plates, including diagrammatic profiles of San Francisco Mountain, O'Leary Peak and a volcanic cone north of San Francisco Mountain; figures representing teeth, skulls, jaws, etc., of various species of animals described in the bulletin; and a map of the United States showing the localities from which specimens of *Crotaphytus baileyi* and *C. collaris* have been examined.

San Francisco Mountain was chosen because of its southern position, isolation, great altitude, and proximity to an arid desert. The area carefully surveyed comprises about 13,000 square kilometers (5,000 square miles), and enough additional territory was roughly examined to make in all about 30,000 square kilometers (nearly 12,000 square miles), of which a biological map has been prepared. No less than twenty new species and sub-species of mammals were discovered, together with many new reptiles and plants; and the study of the fauna and flora as a whole, led to unexpected generalizations concerning the relationships of the life areas of North America, necessitating a radical change in the primary and secondary divisions recognized.

The most important part of the general results are:

(1) The discovery that there are but two primary life areas in North America, a northern (boreal) and a southern (sub-tropical), both extending completely across the continent and sending off long interpenetrating arms.

(2) The consequent abandonment of the three life areas commonly accepted by naturalists, namely: the eastern, central, and western provinces.

(3) The recognition of seven minor life zones in the San Francisco Mountain region, four of boreal origin, and three of sub-tropical or mixed origin.

(4) The correlation of the four boreal zones with corresponding zones in the north and east.

The relation of a biological survey to agriculture is explained as follows:

The primary object of mapping the geographic distribution of species is to ascertain the number, positions, and boundaries ot the natural faunal and floral areas—areas which are fitted by nature for the existence of certain native animals and plants, and which consequently are adapted for the growth of certain agricultural products and for the support of certain kinds or breeds of stock. The obvious reason why certain animals and plants inhabit restricted parts of the earth's surface and do not occur in other parts, where there are no impassable barriers to prevent, is that such species have become adapted to the particular physical and climatic conditions there prevailing, and their sensitive organizations are not sufficiently plastic to enable them to live under other conditions.

The present biological survey of the San Francisco Mountain region has demonstrated that mammals, birds, reptiles, insects, and plants so coincide in distribution that a map showing the boundaries of an area inhabited by an association of species in one group serves equally well for other groups. The reason of this coincidence in distribution is that all terrestrial forms of life inhabiting the same area are exposed to the same surroundings and governed by the same general laws.

The point of greatest significance, so far as the practical agriculturist is concerned, is that what is true of animals and plants in a state of nature is true also of animals and plants as modified by the voluntary acts of man; for every race or breed of sheep, cattle, or swine, and every variety of grain or vegetable, thrives best under particular conditions of temperature, moisture, exposure, and so on. It follows that a map of the natural life areas of a country will tell the farmer what he can expect to produce most profitably on his own farm, and also what crops will *not* thrive in his neighborhood, thus saving the time and cost of experimental farming, which, in the aggregate, amounts to hundreds of thousands of dollars every year.

DIVISION OF CHEMISTRY.

BULLETIN No. 27 (pp. 262).

THE SUGAR-BEET INDUSTRY, H. W. WILEY (illustrated).—This includes an account of the history of the sugar-beet and the manufacture of sugar therefrom in Europe and the United States, mainly condensed from Special Report No. 28 of this Department and Bulletin No. 5 of the Division of Chemistry; statistics of the beet and cane-sugar industries; the methods employed in the production of the seed of the sugar-beet; the varieties of beets grown for sugar; methods of improving these varieties; the cultivation, harvesting, and storing of the sugar-beet; the soil, climate, fertilizers, and meteorological conditions favorable to the sugar-beet; accounts of recent experiments looking to the introduction of the beet sugar industry at the experiment stations in Indiana, Wisconsin, Iowa, Nebraska, and South Dakota; by private parties in Kansas and California; and under direction of this Department in Nebraska, Illinois, South Dakota, and Michigan; brief statements regarding the beet-sugar industry in Canada and England; an article on the introduction of the beet-sugar industry in the northwestern section of this country, reprinted from Special Report No. 28 of this Department; statements regarding the use and treatment of beet pulp; and detailed accounts of the methods and processes employed in the manufacture of beet-sugar. The bulletin is illustrated with numerous plates and cuts showing varieties of beets, implements employed in their cultivation, and machinery used in the manufacture of beet-sugar. There is also a map showing the sections of the United States suitable to beet culture. Foreign sources of information on the subject of the bulletin are freely drawn upon, due credit being given for the material quoted. In the introduction the author earnestly urges the importance of a careful study of the problems yet to be solved in this country before the sugar-beet industry can be profitably carried on here.

In so far as the manufacture of sugar from the matured beet is concerned we are able to start at the present time with the accumulated knowledge and experience of three quarters of a century of investigation. So perfect have the processes of manufacture become that nearly all of the sugar which is stored in the beet can be secured in merchantable form, and by comparatively inexpensive methods. By the term inexpensive, however, it must be understood that the actual processes of manufacture are denoted, and not the cost of the machinery. The various processes for the extraction of the sugar from the beet, the best methods of clarifying the juice and of evaporating it, and for separating the sugar from the molasses, are thoroughly well understood and are no longer legitimate subjects for public experiment. The great problem in this country is the agricultural one. The selection of suitable soil, the finding of the proper climatic conditions, and instruction in the method of planting, cultivating, and harvesting the beets, are all matters of vital importance. Without a careful study of these subjects, and without the proper knowledge thereof, it will be a hopeless task to introduce successfully the beet-sugar industry into this country. * * *

One of the great dangers to be avoided is the formation of hasty conclusions in regard to the proper localities for the production of the sugar-beet. * * *

It has been found in general that the coast valleys of California, and probably large areas near the coast in Oregon and Washington, certain parts of the Dakotas and Nebraska, localities in Minnesota, Iowa, Wisconsin, and Michigan, parts of Northern Illinois, Indiana, Ohio, and New York, present favorable conditions for sugar-beet culture, but in the localities thus broadly intimated there are certain restricted areas most suitable to the sugar-beet, and it is only these restricted areas to which we must look for success. The fact that in one locality, for instance in Nebraska, good sugar-beets can be produced, would be no warrant whatever for assuming that all parts of that State were equally suitable for this purpose, and this remark may be applied to every one of the States mentioned above. * * *

If the sugar-beet industry is to succeed in this country this success must come from sharp competition with the same industry in older countries, where its conditions are better understood and where the localities suited to it have been selected by long and often costly experience. It must also compete with the sugar-cane industry, both of this country and of tropical countries, and for this reason we can only expect it to survive in those localities where soil and climatic conditions, proximity of fuel, cheapness of labor, and other favorable environments are found.

It is hoped that the mistakes which have so long threatened the sorghum-sugar industry with destruction may be avoided with the sugar-beet. Calm judgment and sober reason must not give way to enthusiasm and extravagant expectations. All conditions of success must be carefully studied; all the difficulties in the way of success must be intimately investigated and allowed for, and ample capital, coupled with judicious perserverance, must be enlisted in its behalf.

EXPERIMENT STATION NOTES.

MARYLAND STATION.—The post-office address of the station has recently been changed to College Park, Prince George's County, Md.

MICHIGAN STATION.—L. H. Dewey, B. S., assistant in botany, has resigned to accept a position in the Division of Botany of this Department. G. L. Teller, B. S., assistant in chemistry, has resigned to become adjunct professor of agriculture and chemistry at the Arkansas Industrial University, Fayetteville, Ark. Mr. Teller's place has been taken by A. B. Peebles, B. S., and W. L. Rossman, B. S., has been appointed second assistant in chemistry. G. C. Davis, M. S., assistant in entomology, has been granted leave of absence for two months to prosecute inquiries on the cotton worm for the Arkansas Station.

A feeding experiment with nine steers of the Shorthorn, Hereford, Devon, Holstein, and Galloway breeds has recently been completed. These animals attracted much attention at the State Fair at Lansing, where they were exhibited, and from the butchers and marketmen of Detroit, where they were slaughtered.

MISSISSIPPI STATION.—H. E. Weed, M. S., has been appointed entomologist and horticulturist of the station.

OREGON STATION.—The station staff as at present organized includes B. L. Arnold, M. A., director; H. T. French, B. S., agriculturist; F. L. Washburn, B. A., entomologist; George Coote, horticulturist; and E. R. Lake, M. S., botanist.

TEXAS STATION.—The experiment station council has been abolished and the government of the station is now vested in the director and station staff. S. A. Beach, B. S. A., has been appointed horticulturist, vice T. L. Brunk, B. S.; W. L. Bringhurst has been appointed treasurer of the station, vice L. L. McInnis, M. A. The work of the station is to be mainly concentrated on dairy and creamery lines.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

SEPTEMBER 1 TO OCTOBER 1, 1890.

DIVISION OF CHEMISTRY:

Bulletin No. 27.—The Sugar-Beet Industry.

DIVISION OF STATISTICS:

Report No. 77 (new series), September, 1890.—Report on Condition of Crops in America and Europe and Freight Rates of Transportation Companies.

DIVISION OF ORNITHOLOGY:

North American Fauna No. 3.—Results of a Biological Survey of the San Francisco Mountain Region and Desert of the Little Colorado, Arizona.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, Vol. II, No. 2, September, 1890.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

SEPTEMBER 1 TO OCTOBER 1, 1890.

AGRICULTURAL EXPERIMENT STATION OF FLORIDA:

Bulletin No. 10, July, 1890.—Annual Report for the Year ending June 30, 1890.

AGRICULTURAL EXPERIMENT STATION OF INDIANA:

Bulletin No. 32, July, 1890.—Treatment of Smut in Wheat; Field Experiments with Wheat; A Note on two Inferior Fertilizers.

LOUISIANA STATE EXPERIMENT STATION:

Bulletin No. 1 (second series).—Analyses of Commercial Fertilizers and Other Substances Useful to Agriculture.

Bulletin No. 2 (second series).—Texas Screw Worm.

MARYLAND AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 6, September, 1889.—Commercial Fertilizers.

Bulletin No. 10, September. 1890.—Wheat.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meteorological Bulletin No. 20, August, 1890.

AGRICULTURAL EXPERIMENT STATION OF NEBRASKA:

Bulletin No. 15, September, 1890.—Meteorological Record for 1889; Record of Soil temperatures for 1889; Farm Notes.

NEVADA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 10, July 31, 1890.—The Pear and Cherry Slug.

Bulletin No. 11, September 5, 1890.—Plant Lice Infesting the Apple.

NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS:

Bulletin No. 71, August 14, 1890.—Analyses of Incomplete Fertilizers; Value of Home Mixtures.

NEW YORK AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 23 (new series), September, 1890.—Comparative Test of Cows; Loss in Keeping Manure.

TENNESSEE AGRICULTURAL EXPERIMENT STATION:

Bulletin Vol. III, No. 3, July, 1890.—Points about Country Roads.

TEXAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 11, August, 1890.—Effect of Cotton Seed and Cotton-Seed Meal on Butter Product.

DOMINION OF CANADA.

BUREAU OF INDUSTRIES, TORONTO, ONTARIO:

Bulletin No. 33, July 15, 1890.—Foul Brood among Bees.

Bulletin No. 34, August 12, 1890.—Crops and Live Stock in Ontario.

GUELPH AGRICULTURAL COLLEGE:

Bulletin No. 52, June 16, 1890.—Black Knot on Plums.

Bulletin No. 53, August 26, 1890.—Winter Wheat Experiments.

EXPERIMENT STATION RECORD.

Vol. 2. DECEMBER, 1890. No. 5.

EDITORIAL NOTES.

The need of improvement in the methods for analysis of feeding stuffs and foods and for estimating their nutritive values has been several times insisted upon in the publications of this Office. At the convention of the Association of Official Agricultural Chemists, at Washington, September 10–12, 1889, the subject was earnestly discussed, and a committee, consisting of Messrs. W. O. Atwater, G. C. Caldwell, E. H. Jenkins, W. H. Jordan, and H. W. Wiley, was appointed to consider ways and means for securing more thorough chemical study of foods and feeding stuffs. The report of this committee, presented at the meeting of the association held in Washington August 28–30, 1890, will be published in full in the proceedings. The principal points urged are included in the following statements.

We make analyses of foods and feeding stuffs to determine their values for nourishment, and hence the proper ways to use them. In so doing we classify the ingredients in different groups, and assign to each group a specific nutritive value. By our current methods we make the groups practically the same for all vegetable substances, thus ignoring the differences of kindred compounds in different plants and parts of plants, and even go so far as to make nearly the same grouping for animal as for vegetable compounds. We thus class compounds of widely different chemical and physiological characters in the same group, and frequently put into a group compounds which do not belong there at all. We base our methods of analysis, of separating the ingredients and determining their amounts, mainly upon two classes of properties, their elementary composition and their solubilities, and yet our knowledge of these properties is imperfect at best, and in some cases scarcely suffices for more than to assure us of the incorrectness of our methods. In many instances, especially with vegetable materials, the solubility of the ingredients in laboratory re-agents, their digestibility in laboratory experiments and in the animal's body, and their nutritive effect are dependent upon the ways in which they are held in the vegetable tis-

sues, *e. g.*, the nature of the cell walls or incrusting substances. Of these things ordinary chemical analysis tells us little or nothing, and we must look to the vegetable histologist to find out about them for us. Meanwhile in ignoring them we commit more or less serious error. It is, then, easy to see why, despite the useful investigation that has been done of late by specialists in different lines and by the Association of Official Agricultural Chemists in improving our methods of analysis, the results of analyses by different chemists vary considerably from one another, and our estimates of the nutritive values of feeding stuffs and the results of our feeding trials are at times out of line with the teachings of experience, even if the analyses were carefully made.

In vegetable materials, by our present methods, we determine, or assume that we determine, one group, which we call protein, by multiplying the total nitrogen by 6.25; a second, which we call fats or crude fats, by extracting with ether; a third, which we call fiber or crude fiber, by extracting with dilute acid and alkali; a fourth, which we call ash, by incineration; and a fifth, which we call carbohydrates or nitrogen-free extract, by subtracting the sum of the first four from the total water-free substance, which last we get by subtracting from the whole weight the weight of water as determined by more or less accurate dryings. In animal products used for food we have no crude fiber and the quantities of carbohydrates are generally so small, except in milk and its products, that we neglect them.

Protein.—This term is applied to a large number of materials which differ very widely in chemical and physiological properties. Even the terminology is in great confusion. We may here designate them proteids and non-proteids.

The proteids include the albuminoids, which are abundant in both vegetable and animal materials, and the so-called gelatinoids which are especially characteristic of the connective tissues of animals. The vegetable albuminoids are very imperfectly understood. They are numerous and difficult of separation and are more or less readily transformed into one another. The per cent of nitrogen, which should be 16 to make the ordinary factor 6.25 correct, varies considerably not only in different classes of albuminoids but in those of the same class from different species of plants, and if the results obtained by different investigators are to be relied on, in those of the same class from different plants of the same species. With the animal albuminoids that chiefly concern us the case is somewhat simpler. They appear to be less in number, those which we group together are perhaps more nearly alike in chemical constitution, and they change less with the growth and development of the organism and in the keeping and handling in the laboratory. Generally speaking the nitrogen factor 6.25 is not far out of the way for them. Still we must learn much from organic chemistry and histology before we can know how to separate and determine them and judge of their nutritive values with accuracy. The same is true of the gelatinoids, of which really but little is definitely known.

The non-proteid nitrogenous compounds include those to which the term amides is often applied, and which occur chiefly in plants; those which are frequently grouped with kreatin and are more characteristic of animal substances; and others, such as the lecithins, alkaloids, and nitrogenous glucosides which occur to greater or less extent in either vegetable or animal materials or in both. They are widely divergent in chemical composition, and while some of them have a high nutritive value, others, including many with the highest percentages of nitrogen, neither form tissue nor yield energy in the body. At present there is no satisfactory way of determining them. Even the methods for "non-albuminoid" nitrogen in vegetable substances do not stand the test of critical experience. All of them demand further investigation.

It is perfectly clear then that the practice of determining the total nitrogen, multiplying it by 6.25, calling the product protein, and using it as a measure of the nutritive value of the nitrogenous ingredients is a very rough and inaccurate way of doing things.

Fats—Ether extract.—The case with the so-called crude fat is no better. In such animal substances as muscular or connective tissue, milk, and products from it, the ether extract. if obtained by proper manipulation, contains the fatty bodies and little else. But the compounds we extract from vegetable products and denominate as crude fat, ether extract, or for short, fats, are very diverse, nor are we at all sure what proportion of them we extract by our ordinary methods. We have to deal not only with the true fats, *i. e.* glycerides of the fatty acids, and the fatty acids themselves which may be properly classed with the fats in estimating nutritive values, but also with a great variety of other compounds of widely differing constitution, and of whose functions and value in nutrition but little is known. Among them are substituted glycerides including lecithins, waxes, alkaloids, cholesterin, hydrocarbons, and chlorophyls. Of these, the lecithins appear to have a special value in nutrition, while some of the alkaloids are poisons.

If the substance to be analyzed is finely ground, free from water, and in otherwise normal condition, and the cell structure allows easy extraction we may in general expect that ether, applied in accordance with the official method which is commonly followed by the stations, will take out the whole of the true fats and fatty acids, and more or less of the lecithins, wax, chlorophyl, cholesterin, alkaloids, and hydrocarbons, and that more or less of the compounds other than true fats and fatty acids will remain undissolved. If the ether contains alcohol the extract may be expected to contain more of the other compounds. If water is present the extract may be larger, as has actually been found to be the case in numerous observations.

In other words, the extract, as obtained by the ordinary method contains part or all of the fats and fatty acids and with them more or less of other substances.

There is only one way to remedy this difficulty. It is to find what the

substances are which vary so greatly in solubility, in what materials and under what conditions they occur, and how to classify, separate, and determine them.

The nutritive values of the materials which are more properly grouped as fats, *i. e.* the glycerides of the fatty acids and the fatty acids themselves, are pretty well understood, though further investigation of the molecular constitution of some, and of the potential energy of all, is needed. According to the present outlook it seems probable that, although the waxes and perhaps the lecithins may be classed with the fats in estimations of the nutritive values, a separate classification of some or all of the others will be necessary; and it is clear that a more definite knowledge of the chemical constitution of all the materials, other than the neutral fats and fatty acids, is indispensable to any correct estimate of their values for nutriment.

Nitrogen-free extract—Carbohydrates—Crude fiber.—For purposes of analysis and determination of nutritive values it will probably prove desirable to reclassify these substances on the basis of their solubilities, not only in water and dilute acid and alkali, but also by such means as treatment with steam at high pressure, and with digestive ferments. The sugars, starches, so-called insoluble carbohydrates, indeed all the materials which we now crudely group together as non-nitrogenous extractives, and those which we call crude fiber demand study. It is essential to investigate carefully the carbohydrates which occur in different plants and at different periods of growth and to learn their behavior with solvents and their methods of separation. It is also important to learn more about their digestibility and the ways in which they are utilized in the body. Much of the information must be gained by the methods of vegetable physiology and histology, rather than by purely chemical methods.

Of the nutritive values of some of the carbohydrates, especially those which are soluble in water or are rendered soluble by the diastatic ferments, we have some definite knowledge. For instance, the ordinary sugars may be reckoned as completely digestible, and the potential energy of a number of them has already been determined, and others are being studied. The problem here is comparatively simple. With those that are not dissolved by either water or the digestive ferments the case is somewhat more complicated, but it is to be hoped that research of the kinds now being carried on so successfully by several chemists in this country and in Europe will bring, before many years, much of the definite information which is needed.

As regards the bodies which we are wont to classify as amides, ether extract, nitrogen-free extract, and crude fiber, and which we attempt to estimate by treatment with water, ether, dilute acid and alkali, or other solvents, we are coming to appreciate that their solubility is influenced not only by the fineness of grinding of the sample, the time and temperature of the extraction, the quantity of the water, the purity

of the ether, the strength of the acid or alkali, the time and temperature of extraction, and by chemical changes induced in the compounds by fermentation, or by long standing, or by drying in air, but also by the ways in which they are held within the cells or occur as constituents of the plants. The observations of the greater digestibility of cellulose in young than in older plants and in plants grown on rich as compared with those grown on poor soil, illustrate this point. We are beginning to realize that the permeability of the cell walls and other mechanical conditions affect the ease or difficulty of extraction; that the histological structure of the plant is a most important factor; in other words, that here is one of the places where the chemist must have the help of the vegetable physiologist if he will learn how to do his work as it ought to be done.

The need of an understanding of the molecular constitution of compounds in order to devise correct methods for learning their digestibility and nutritive values is illustrated by the albuminoids. What is the residue left undissolved by pepsin and trypsin to which the term nuclein has been applied? Is there reason for a separate classification of nucleo-albumens? Is there in these or other albuminoids a molecular group containing phosphorus which resists the digestive ferments and is the basis of the undigestible portion of the compounds in which it occurs? If so, what is its relation to the nucleus or the nucleolus of the cell? Shall we not have to look to a union of organic chemistry and vegetable physiology for the facts we must have in order to devise plans for correct analyses and determinations of digestibility, potential energy, and nutritive value of the compounds?

The results of future research will doubtless lead not only to changes in the general groupings and methods of analysis, but also to special groupings and methods of analysis for different classes of vegetable and animal foods and feeding stuffs. It is hardly to be expected, for instance, that we shall always hold to the same grouping of compounds for grasses, cereal grains, leguminous plants and their seeds, root crops, milk and meats. It is more probable that groupings for different classes of materials which shall correspond with methods of analysis and of estimating the nutritive values, will prove both necessary and feasible.

It is safe to say that all of the work we have done in the past and are doing to day in the analysis of feeding stuffs and the feeding trials based upon them will have to be revised and much of it discarded. In other words, a large amount of work is being done which is not bringing the needed results, can not in the nature of the case be of the highest and most enduring value, and much of which may have to be done over again when correct methods shall have been devised.

The first step toward reform must be research in analytical, organic, physical, and physiological chemistry. The needed improvement of our methods will evidently come only as fast as does the chemical and physiological knowledge which must serve as a basis for changes. This

means that the most abstract and profound study is necessary. Fortunately such study is more and more engaging the attention of chemists and vegetable physiologists.

From the chemical standpoint we need: First, such studies as will bring definite knowledge of the kinds and amounts of proximate compounds contained in each substance to be analyzed—that is to say, (1) in different species of plants, as grasses, grains, cereals, legumes, tubers, roots, etc.; (2) in plants of the same species grown under different conditions; (3) in different parts of the same plant, as the stalk and seed of maize and wheat, and the different parts of the wheat grain; (4) in the same plant at different periods of growth; (5) in animal substances. For some of the information needed the aid of the histologist must be sought. Second, studies of each compound regarding its behavior with re-agents—*i. e.* solubility, etc.; its elementary composition; its cleavage products; its molecular constitution; the changes it undergoes by the action of ferments; its digestibility, and its potential energy. Third, classifications of the compounds based upon the properties named. Fourth, improved methods for separation and estimation based upon the same properties. Fifth, as the outcome of all this, more correct methods of estimating the nutritive values.

Investigations in these lines have been already undertaken by the Division of Chemistry of the United States Department of Agriculture, by several of the experiment stations, and by other institutions of research. The work of the Association of Official Agricultural Chemists in developing and improving the methods of analysis has been of the very greatest value. For the collating of the results of previous inquiries, and for the prosecution of the necessary investigations, co-operation of a large number of specialists will, of course, be requisite. We may confidently expect that experiment stations will be able to devote more and more labor to these higher inquiries. The increased resources of our agricultural colleges will enable them to encourage such researches. The scientific value of this work is such that chemists in other colleges and universities ought to be led to join in it. And is it too much to suggest that international co-operation might be secured? The expense of this research may be best met by the wise expenditure of relatively small sums of money judiciously distributed, so as to stimulate investigations and bring them to completion. In what the Smithsonian Institution has done in times past in promoting research by small amounts of money, we have an illustration of what might be accomplished here. The result would be useful in several ways. It would encourage research, develop talent and improve the intellectual tone of the institutions where such work was being done. Its influence upon the development of science in this country would be excellent and the practical value of the outcome would many times exceed the cost.

ABSTRACTS OF BULLETINS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

Alabama College Station, Bulletin No. 16 (New Series), June, 1890 (pp. 20).

SOME CONCLUSIONS FROM EXPERIMENTS WITH FERTILIZERS, J. S. NEWMAN (pp. 3-16).—" Under a judicious rotation of crops, including those which are humus-supplying, little else than phosphates need be purchased by the corn and cotton grower" in Alabama. Suggestions as to rotation and a discussion of the importance of leguminous plants for this purpose, directions for the most advantageous use of pea vines, cotton seed, stable manure, and phosphate, and formulas for composting the last three for corn, cotton, and other crops are given.

The following is a summary of conclusions from experiments by the station during six years. They apply, of course, under the conditions of soil, fertilizers, and crops there prevailing:

Phosphatic fertilizers.—Phosphoric acid leaches but little, if any, upon clay soils or those having clay subsoils, but does leach through sandy soils with sandy subsoils. Citrate-soluble phosphoric acid possesses equal agricultural value with water-soluble. The phosphoric acid from floats or phosphate rock ground to an impalpable powder, gradually becomes available in the soil, but produces very little effect upon the first crop. The availability of the phosphoric acid in floats is hastened by use with cotton-seed meal. Plants are indifferent as to the sources from which available phosphoric acid is derived.

Nitrogenous fertilizers.—Nitrogen leaches rapidly through sandy soil unless occupied by feeding roots or underlaid by clay subsoil. Plants are indifferent as to the sources from which their supply of nitrogen is derived, but those sources which yield a supply gradually, as needed by the plant, are best suited to our long season of growth. Of the commercial sources of nitrogen, cotton-seed meal is cheapest and most reliable. It yields its plant food more gradually than either the mineral or animal sources.

Cow-pea as a fertilizer.—Pea vines, grown upon the land and left to protect the surface until preparation is made for the next crop, furnish the cheapest source of nitrogen in the most desirable condition. Thus grown and treated they furnish the most reliable and practicable means of improving worn lands. Pea vines cut for hay, leaving the stubble and roots on the land, benefit the soil more than turning them in green during the summer. They pay best when left upon the surface till the land is needed for another crop.

Potash fertilizers.—Potash applied to the soil of this station has not been profitable except during drouth. Its principal benefit seems to result from its affinity for moisture. Plants seem indifferent as to the source of supply from which they derive the potash needed.

Methods of cultivation.—Following thorough preparation of the soil, shallow cultition produces larger crops at less cost than deep cultivation. Impoverished soils may be rapidly restored to productiveness by terracing, accompanied by a judicious rotation of crops involving a restoration of humus.

Farm manure.—The best way to utilize the animal manures saved on the farm, and the surplus cotton seed, is in compost with acid phosphate. Contrary to the general opinion, ammonia is not volatilized and lost from such compost during the fermentation.

Fruits.—Grapes, peaches, plums, raspberries, strawberries, and the oriental type of pears can be grown profitably under intelligent culture.

Stock and feeding.—Growing wool and mutton, intelligently pursued, is more profitable than growing cotton. A profit of 50 per cent upon the value of the sheep and the cost of keeping them can be realized. Pork can be grown here as cheaply as in any State in the Union by cultivating our peculiar crops especially for swine. Green crops for soiling cattle may be had in abundant supply, during the entire year, from the cereals, lucern, corn, sorghum, and peas. By means of these and silage, pasturage may be dispensed with.

FIELD EXPERIMENTS IN 1889, J. S. NEWMAN (pp. 16–20).

Fertilizers for corn.—The objects of the experiment were (1) the comparison of crushed and uncrushed cotton seed with each other and with cotton-seed meal; (2) comparison of raw phosphate with acid phosphate; and (3) the study of the relation between the different parts of the plant as affected by fertilizers. The land had been planted in cotton in 1888, for which it was liberally manured, so that the contrast between the fertilized and unfertilized plats is in some instances not striking. A tabulated statement shows the yield and the relation of parts of the plant on twenty-one plats. Of the plats on which nitrogenous fertilizers were used alone, those treated with dried blood gave the largest total yield, and the largest proportion of corn to stover and of corn to cob; with sulphate of ammonia, dried blood, and cotton-seed meal, each combined with acid phosphate and muriate of potash, the yield was practically the same in each case; while with nitrate of soda combined with the phosphate and muriate it was somewhat lower. With green cotton seed applied alone and in combination with acid phosphate and muriate of potash the yields were slightly lower than with crushed cotton seed; but with the crushed cotton seed in combination with raw phosphate and muriate of potash, the yield was higher than with any other fertilizer used. With cotton-seed meal the results were about half way between those with green and crushed cotton seed. "The relation between the different parts of the plant seems not to be materially affected by the different manures."

Tests of varieties of corn and cotton.—Tabulated notes of trials with 20 varieties of corn and 15 varieties of cotton.

Planting cotton at different distances.—A tabulated statement of the results on twenty-three fourth-acre plats.

Rye as a soiling crop in winter.—Rye was sown in drills, September 25, on a piece of land from which a crop of cabbages had been taken. The land had been well fertilized for the cabbages, but received no further

application of fertilizer for the second crop. Four cuttings, made in October, November, January, and February, gave a total of 10.7 tons of green rye for 1 acre. "No farm in the cotton States should be without its patches of rye or barley, to be cut or pastured during fall, winter, and spring."

Chufas.—Half an acre of "very thin, sandy land" planted to chufas gave a yield of 172 bushels of green nuts per acre.

Alabama College Station, Bulletin No. 17 (New Series), July, 1890 (pp. 18).

DRY APPLICATION OF PARIS GREEN AND LONDON PURPLE FOR THE COTTON WORM, G. F. ATKINSON, PH. B. (pp. 3–16).—Under this head are summed up the replies from twenty-one practical cotton growers in different parts of the State to a circular of inquiry sent out by the station with reference to the method described below for applying the arsenites for the repression of the cotton worm (*Aletia xylina*). The experience with the same method on the station farm is also described. Only one reply unfavorable to this method was received.

In the method of application described in the bulletin, Paris green or London purple in a dry form "is allowed to dust through osnaburg bags suspended at the end of a pole, the pole being carried by a man mounted on a mule, and the animal trotted across the field."

Extracts from the correspondence are given and the substance of the replies is collated in a table, which is accompanied by "remarks upon the nature of the replies and their practical bearing."

REPORT OF THE ALABAMA WEATHER SERVICE (pp. 16–18).—This is for May, 1890, and includes notes on the weather, a State summary of observations, and a monthly summary of reports by voluntary observers in twenty seven counties of the State.

Alabama College Station, Bulletin No. 18 (New Series), August, 1890 (pp. 73).

CLIMATOLOGY OF ALABAMA, P. H. MELL, PH. D.—This includes a large amount of tabulated notes and other information compiled from meteorological observations taken from 1811 to 1890, with general notes on climatic phenomena from 1711 to 1890.

The earliest systematic work of collecting meteorological data in Alabama was under the auspices of the Smithsonian Institution, about forty years ago. Prior to that time a few observers reported at irregular intervals to some of the agricultural journals the reading of thermometers and rain-gauges, and in many issues of the papers of that early time frequent references were made concerning the general conditions of the weather and the effects produced upon the crops. In the preparation of this bulletin careful examination has been made of the following publications, from which much valuable data have been collected:

Southern Cultivator, Soil of the South, Country Gentleman, Farm and Home, Southern Field and Fireside, Smithsonian Institution publications, Patent Office reports, Signal Service reports, and bulletins of the Alabama weather service.

In 1870, stations were established by the United States Signal Service at Mobile and Montgomery, Alabama. This service was enlarged in 1880 with the aid of depot masters at a number of railroad stations and of voluntary observers in different parts of the State. In 1881 a meteorological station was established at Auburn in connection with the Alabama Polytechnic Institute, and in 1884 this was made the central station for the weather service of Alabama.

At the present time the system is on most excellent footing and is doing most efficient service to the people of the State.

A bulletin is issued at the end of each month, and special weekly bulletins during the crop seasons on Saturday mornings, indicating the effects of the weather on the crops. At irregular periods special bulletins have been issued upon some meteorological subject, written by experts. In the reports that have been sent to the central station during the past five years we find not simply dry figures, but they also include much that is interesting concerning the planting and reaping of crops; the occurrence of frosts and damages resulting from floods; much concerning the health of the people of the State as affected by sudden changes of the atmosphere; the passage of cold waves; flight of birds; ravages of insects and great storms.

The principal contents of the bulletin are as follows: diagrams of the weather and temperature flags of the signal service, with explanations; a table showing the history of meteorological work in Alabama, which includes the location, latitude, longitude, and elevation of each station, date of opening and closing of the station, character of the observations, and names of observers and of authorities to whom reports were made; temperature and rain-fall data from a number of stations where observations were made for several years; a diagram showing for the entire State the maximum, minimum, mean maximum, mean minimum, and average temperatures, for periods of from two to twenty-one years; descriptive notes on the years of drought, of excessive rainfall, and of destructive storms; tabulated data on tornadoes in Alabama, with a map showing the track of these storms, taken from an article by Lieut. J. P. Finley in the *American Meteorological Journal;* descriptive notes on cold winters and warm summers; list of the years of good and bad crops; notes on the winds prevalent in Alabama, with a diagram showing the annual average direction of the wind from 1884 to 1889; a meteorological summary for Alabama for each year from 1884 to 1889 inclusive; two maps of Alabama, showing the normal temperatures and precipitations; and an appendix containing tabulated data for observations of soil temperatures taken at the station during 1888 and 1889, with a diagram showing the average temperatures of the soil and the maximum and minimum temperatures of the atmosphere for each month of 1889.

Some general conclusions.—Alabama is so situated in relation to the parallels of latitude and the difference in elevation between the southern and northern portions that many of the plants necessary for man's sustenance and pleasure may be successfully grown within her borders. Her climate is so varied, without great extremes, that most of the plants peculiar to tropical regions are grown in the belt bordering the Gulf; and the cereals and forage plants common in the North and West are success-

fully cultivated in her mountains and upper valleys. The health of the people of Alabama can compare favorably with any other country on the globe. Violent epidemics are very rarely found within her borders, and whenever, after long years, yellow fever or cholera finds lodgment on her soil it is due entirely to immigration and the disease soon spends itself in the locality where it first finds foot-hold. The thermometer seldom goes above 100°, and only now and then in years does it range a degree or so below zero. It is considered to be extremely cold when the temperature reaches 10°, and intensely hot when the thermometer records 100° in the shade. Not more than two or three days in the year give such high temperature, and only a few localities in the State. The atmosphere is moist enough to produce a cooling sensation on the skin when the breeze passes across the heated person as it sweeps in from the west and northwest. The average rain-fall for the entire State is only 52.12 inches, and at no place does the normal precipitation run above 65 inches. * * * The least annual rain-fall is 41.75 inches, and the greatest is 64.96 inches. It is thus seen that the atmosphere is neither too dry nor too moist for the most luxuriant production of vegetation and for the best condition for the health of the inhabitants of the State.

The highest normal average temperature is 82.2° in July and the lowest is 43.1° in January, giving a range of 39.1°. The winters are seldom very cold and the summers are not excessively warm. The last frost in spring occurs on April 15, and the first frost in the autumn comes on November 15, so that the farmer is blessed with seven months in which no cold occurs sufficiently severe to even nip the most tender bud, except at rare intervals, already indicated in the previous page of this bulletin. It is a fact well known that because of this long season for growing and maturing plants sometimes several crops are gathered on the same body of land in the same year.

The cold weather does not begin until December, and only one month in the winter is really disagreeably cold, viz., January. The winter is usually mild, and snow seldom falls heavy enough to cover the ground more than 2 or 3 inches.

Soil temperatures.—There are three groups of instruments so arranged as to give the temperature of moist soil, and as near as possible, an average dry, sandy soil. The first set consists of nine thermometers, viz: 1, 3, 6, 9, 12, 24, 36, 48, and 60 inches respectively, that are buried on the banks of a running stream of water, in bottom, sandy land. The other two sets—one consisting of the same number of thermometers as above, and the other the same number with three additional, viz.: 72, 84, and 96 inches—are buried on the top of a hill in sandy soil that is often stirred during the crop season.

The observations of soil temperatures have not been taken long enough to produce normal results, but it is interesting to note some features in the accompanying tables.

(1) In January the average temperature of the soil in the bottom-land within 2 feet of the surface is about 1 degree higher than it is on the hill. The two places in February produce practically the same results within a depth of 2 feet. In March the bottom is slightly cooler. In April, May, June, and July the results are practically the same. In August and September the bottom is again nearly 1 degree warmer, while in November and December the hill soil is slightly warmer than the bottom soil.

(2) There is a gradual increase of temperature in the winter months from the surface to the depth of 8 feet, averaging 7.3°, greatest in January (10.1°) and least in December (3.9°). In the spring months there is a decrease in temperature to 8 feet, averaging (8.3°), least in March (1.9°) and greatest in May (13.7°). In the summer months the stratum of earth at 8 feet depth is 12.7° cooler than that of 1 inch below the surface. It is 15.4° cooler in July and only 7.7° cooler in August. In September the 8 feet stratum is only 4.5° cooler, while in October it it 3.3°, and in November 10.4° warmer than the 1-inch stratum.

(3) In the middle of summer the 8-feet soil thermometer registers an average tem-

perature 9.9° cooler than the average temperature of the air, while in January it is 10.6° warmer than the atmosphere.

(4) The difference between the average January temperature of the 8-feet soil thermometer and the July temperature of the same thermometer is 13.3°, while the difference between the January and July average atmospheric temperature is 33.8°.

Alabama Canebrake Station, Bulletin No. 8, April 1890 (pp. 8).

CATTLE FEEDING, W. H. NEWMAN, M. S.—The experiment, which "was undertaken to compare the feeding value of the products of canebrake soils," is a trial of stall feeding of four animals for beef. Nos. 1 and 2, work oxen, ten to twelve years old, and No. 3, three to four years old, had been at pasture during summer; and No. 4, a "turned-off work steer," was about eight years old.

The animals were all in fairly good condition. The feeding extended from November 4, 1889, to February 17, 1890, during which time various mixtures of pea-vine hay, "mixed hay," rye hay, and cotton-seed hulls, with green cotton seed, cotton-seed meal, and corn on cob were fed during five periods of twenty-one days each, and the increase (or decrease) in live weight for each period noted. Tables give the food consumed by each animal, gain in live weight, total cost of food, and cost per pound of increase, by periods, a summary of which follows:

Food consumed, cost of food, and total gain in live weight per animal during entire experiment.

	Food consumed in pounds.									Cost of food.	Total gain.	Gain per day.
	Pea-vine hay.	Mixed hay.	Mixed hay and hulls.	Rye hay and hulls.	Green cotton seed.	Cotton-seed meal.	Cotton-seed hulls.	Corn meal.	Corn and cob.			
											Lbs.	*Lbs.*
No. 1	539	557.75	....	735	755	....	335.5	....	......	$13.03	24	0.22
No. 2	631	676.5	671.5	....	....	390	639.5	......	....	14.52	192	1.82
No. 3	1,904	348	....	....	....	....	....	229.5	122.75	13.60	180	1.71
No. 4	....	....	....	....	....	799.5	3,716.75	......	....	17.26	270	2.57

The four animals consumed in one hundred and five days 14,354¼ pounds of hay and cotton-seed hulls, and 2,285 pounds of cotton seed, cotton-seed meal and corn, and corn-meal, or a total of 16,639¼ pounds of food. This enormous quantity of food produced only 666 pounds of gross increase at an aggregate cost of $58.41. It required 25 pounds of the mixed food to produce 1 pound of gross increase, and this cost 8.8 cents per pound. At 3¾ cents per pound the increase was worth $24.97; the total cost of the food was $58.41. This leaves a balance of $33.43, for which the manure is the only asset. The changes rendered necessary in the rations of some of the steers on account of refusal to eat portions of them caused some unprofitable consumption. The results indicate that stall feeding at present price of beef cattle is not profitable.

PIG FEEDING, W. H. NEWMAN, M. S.—The object of this experiment was to "compare the nutritive effects of whole corn and corn meal" in feeding pigs. Four thoroughbred Essex pigs, all from the same litter, nine months old, averaging 79 pounds in weight and "in good store condition," were used. One pair, Nos. 1 and 2, were fed a full ration of corn meal; the other, Nos. 3 and 4, received all the whole

corn they would eat. A preparatory period of seven days preceded the experiment. The first feeding period extended from November 12 to December 9, and the second period from December 31 to January 20—twenty-one days each. During the three weeks' interval between the first and second periods the pigs ran together in a pasture and were fed whole corn for two weeks, the third week being a preparatory period.

First period: Nos. 1 and 2 each received daily 8.6 pounds of corn meal and consumed 3.30 pounds of food, costing 2.64 cents per pound of pork produced; Nos. 3 and 4 each received daily 7.35 pounds of whole corn and consumed 5.36 pounds of food, costing 3.46 cents per pound of pork produced.

Second period: Nos. 1 and 2 each received daily 10.28 pounds of corn meal and required 3.23 pounds of food, costing 2.58 cents for the production of 1 pound of pork; Nos. 3 and 4 each received daily 6.54 pounds of whole corn and required 3.84 pounds of food, costing 2.39 cents for the production of 1 pound of pork.

In other words, the two pigs fed corn meal gained in the two periods 122 pounds on food costing $3.17, or 2.6 cents per pound of increase; and the two pigs fed whole corn gained, in the same time, 63.5 pounds on food costing $1.82, or 2.87 cents per pound of increase. "When butchered the meat of those fed upon corn meal was whiter and firmer than that of the corn-fed pigs."

Arkansas Station, Bulletin No 12, April, 1890 (pp. 12).

INFLUENCE OF SPAYING ON MILK PRODUCTION, R. R. DINWIDDIE, V. S.—This experiment was undertaken (1) to study the effect of spaying on the quantity and quality of milk, and (2) to observe the length of time a cow of average milking capabilities will continue to give milk in paying quantity after spaying. Two "average milking cows of the district," each four years old, were spayed by the Charlier method two months after calving. Each cow received daily 12 pounds of hay, 6 pounds of wheat bran, 1.5 pounds of cotton-seed meal, 3 pounds of corn meal, and pasturage during the day. A table shows a decrease in one case of 8 and in the other of 12 pounds in live weight (as indicated by the scales) after spaying, followed after about two weeks by a regular increase. The average of the analyses and daily weights of the milk of each cow before and after spaying was as follows:

Quantity and quality of milk before and after spaying.

	Cow No. 1.		Cow No. 2.	
	Before and at time of spaying, Dec. 24–Jan. 4.	After spaying, Apr. 30–May 9.	Before and at time of spaying, Dec. 24–Jan. 4.	After spaying, Apr. 30–May 9.
Total milk per day ....ounces..	182	225	159	197
Per cent of solids	14.37	14.72	13.80	13.70
Per cent of fat	4.63	4.93	4.43	4.33
Total fat in milk per day ...ounces..	8.41	11.12	7.05	8.21

It appears that the cows suffered little from the immediate effects of spaying, the shrinkage of milk, which may be taken as a measure of their physiological disturbance, being limited practically to the first two or three days following the operation. As for the quantity, even allowing for the better pasturage during the last month, the showing is good. There is certainly no falling off in the amount such as might be expected to occur in the non-castrated cow nine months after calving, but neither is there any very noticeable increase.

The quality of the milk as indicated by chemical analysis did not, four months after spaying, differ to any extent from what it was before, nor were the proportions of cream and casein increased.

The experiment with these cows will be continued.

COTTON-WORM PROSPECTS, C. W. WOODWORTH, M. S.—Brief statements regarding the hibernation of the cotton worm are published, in view of the unfounded apprehension of many planters that the warm winter of 1889–90 would be followed by a serious invasion of these insects. Practical directions concerning remedies are also given.

Arkansas Station, Bulletin No. 13, August, 1890 (pp. 8).

STRAWBERRIES, J. MCNEILL, B. S.—Tabulated notes are given for seventy-one varieties of strawberries tested at the station at Fayetteville in 1890, and for twenty-three other varieties planted this season. There are also brief descriptive notes on some of the varieties. A cold and rainy spring and a dry summer seriously interfered with the growth of these berries. "Not more than half a crop was gathered and the fruit was below the average in quality, though perhaps not in size." Taking into account productiveness, thriftiness, and freedom from leaf blight, the three best varieties in their respective classes have been the following: *Early*—Logan, Sharpless, and Miner; *medium early*—Daisy, Cloud, and Crescent; *medium late*—Warfield No. 2, Bubach No. 5, and Louise; *late*—Eureka, Haverland, and Glendale.

"Three varieties which *remain longest in bearing*, and which *produce most berries* at the *beginning* and *end* of the season—Jersey Queen, Captain Jack, and Eureka.

"My choice for a home garden—Sharpless, Haverland, Bubach No. 5, Crescent, Warfield No. 2."

Arkansas Station, Bulletin No. 14, September, 1890 (pp. 14).

THE EFFECTS OF THE ARSENITES UPON PLANTS, C. W. WOODWORTH, M. S.—Results of investigations in this line by Professors Riley, Cook, and Bailey are cited to show what has been done and the further inquiry needed. The original intention of the author was to apply the poisons to shrubs or trees or to measured areas of clover or grass, but, owing to a lack of suitable plants and to the difficulty of accurately estimating the amount of injury, after a few trials it was decided to make

the applications on single leaves. The arsenites were applied in three ways, viz., (1) by jarring from a stiff brush, (2) by painting on the leaf with a soft brush, and (3) by dipping the leaf in the mixture. The problems studied were: (1) the relative amount of injury to the plant by different arsenites; (2) the relation between the strength of the poison and the amount of the injury; (3) the difference in the action of the poisons on different plants; (4) the amount of variation in the action of the poisons on different varieties of the same plant; (5) the effect of the age of the leaf on the amount of injury; (6) the difference in the susceptibility of the different sides of the leaf to the effects of the poisons; and (7) the relation of the earlier to the ultimate effects of the poisons. The details are reported in tables.

(1) *Amount of injury.*—Paris green, London purple, and fresh and old mixtures of white arsenic were applied to 1,180 leaves of the apple, peach, sassafras, cotton-wood, and grape, causing 22, 56, 4, and 58 per cents of injury respectively. The noticeable thing here is the small amount of injury caused by the fresh mixture of white arsenic.

(2) *Relation of strength of poison to injury.*—The three arsenic compounds were applied to 828 leaves of the above-mentioned plants for the most part in the proportions of one part of the poison to 100, 200, and 400 parts of water. The amounts of injury by Paris green decreased quite uniformly with the decrease in the strength of the mixture, but the effects of London purple and particularly of white arsenic were not uniform.

(3) *Different effects of the poisons on different kinds of plants.*—In the case of applications of the three arsenic compounds to 240 leaves each of the apple, peach, and grape, the per cents of injury to the respective kinds of plants were estimated at 39, 25, and 51, the relative amounts of injury by the different arsenites remaining the same as in the first experiment. A secondary effect, not apparent until after a week or more, was observed on the older peach leaves. If this were taken into account the injury to the peach would be increased 10 per cent.

(4) *Variation in the injury to different varieties of the same kind of plants.*—Eight leaves of each of forty-four varieties of grapes were treated with Paris green, London purple, and fresh and old white arsenic. The estimated per cents of injury varied from 15 for the Thomas variety to 75 for the Wilder.

(5) *Effect of the age of the leaf on amount of injury.*—Seven hundred and seventy-four leaves, equally divided between old and young, of the apple, grape, sassafras, and peach, were treated with the three arsenic compounds. The old leaves suffered more than the young ones, except in the case of the grape where the per cents of injury were equal. In a general way this confirms previous observations by Professors Cook and Bailey.

(6) *Difference in susceptibility of different sides of the leaf.*—Eight hundred and twenty-eight leaves of the apple, grape, sassafras, peach, and cotton-wood were painted on the upper or lower side or on both sides. The three arsenic compounds were used in different ways. In the case of the apple, grape, and sassafras the lower side was much more susceptible than the upper. "Except in the case of the peach an application to both sides was more injurious than to either side alone, but not as injurious as the sum of the application to the two sides." In the case of the peach the three different forms of application produced about the same amounts of injury.

(7) *Relation of earlier to ultimate effects of the poisons.*—Observations made two and eight days after the application of the arsenic compounds to grape leaves indicated that white arsenic and London purple produce their effects more quickly than Paris green, and that young leaves and the lower side of the leaf are affected more quickly than older leaves and the upper side.

Connecticut Storrs Station, Bulletin No. 6, August, 1890 (pp. 16).

GRASSES AND LEGUMES, C. D. WOODS, B. S., AND C. S. PHELPS, B. S.—The purpose of this bulletin is to call attention to (1) some of the plants grown in the grass and forage garden of the station, (2) the outcome of trials on the growth of plants for hay and green fodder, and (3) especially the high feeding and manurial values of some leguminous plants which are or can be grown in Connecticut.

The new results here reported consist mainly of observations on the growth of eight species of legumes: horse bean (*Vicia faba*), soja bean (*Soja hispida*), cow-pea (*Dolichos sinensis*), vetch (*Vicia sativa*), white lupine (*Lupinus alba*), blue lupine (*Lupinus hirsutus*), yellow lupine (*Lupinus luteus*), and clover (*Trifolium pratense*); and one of grass, tall meadow fescue (*Festuca elatior*), with analyses of the products, including roots and stubble.

A study of the effects of nitrogenous fertilizers upon the quantity and composition of the grass crop, similar to that begun upon corn, already reported,* was commenced the present season. These experiments have, for the most part, been conducted in the forage garden and upon the school farm, though a few have been on farms in different parts of the State. It is planned to continue this work, the present bulletin being regarded merely as a report of progress. As the purpose of the present bulletin is to give brief statements of results for use of farmers, the details are reserved for publication in the next annual report of the station.

The principal contents of the bulletin are a brief description of the grass and forage garden of the station; a list of seventy-one species of plants grown in this garden in 1889–90; descriptions of five species of promising grasses for trial in the State; reasons why legumes are especially valuabie for feeding and manures; descriptions of the principal species of legumes grown at the station; a table giving the results of analyses of the species of legumes and grass mentioned above, with comparative data for corn, corn stover, timothy, hay, and timothy and

* Connecticut Storrs Station, Reports, 1888, p. 72, and 1889, pp. 103 and 127.

redtop hay as compiled by Dr. Jenkins, of the Connecticut State Station; three other tables giving (1) the tons of green crop and pounds of protein, fat, nitrogen-free extract, and fiber per acre as computed from the analyses reported in the first table, (2) the pounds of each nutritive ingredient in 1 ton of these legumes (with the exception of the soja bean), and (3) the fertilizing ingredients in the crop and roots per acre in the same species; and suggestions regarding the value of legumes for green manuring. The following summary is taken from the bulletin:

In order to make the best hay it is necessary to cut the grass at the proper degree of maturity. It is difficult to do this when too heavy an acreage of any one species is grown, and on this account it is advantageous to grow grasses maturing at different times. In the experiments by the station here reported, the most promising appear to be orchard grass, tall meadow fescue grass, tall meadow oat grass, fowl meadow-grass, and perennial rye grass. The importance of obtaining pure seed can hardly be overestimated. Farmers are recommended to try small plats of some of these grasses and discover for themselves their adaptability to their own needs.

The legumes, clover, lupine, vetch, pea, bean, etc., are especially valuable because of—

(1) Their large percentages of protein compounds which serve to form blood, muscle, bone, and milk, and their consequent feeding value, which exceeds that of the grasses, corn fodder, corn stover, or straws. They may be used to supplement these fodders in place of the concentrated nitrogenous feeds, such as bran, cotton seed, linseed, and gluten meals, etc. Hay from the legumes is twice or more than twice as rich in protein as that from the grasses.

(2) Their power of gathering large quantities of plant food from natural sources. Many if not all of our common legumes acquire considerable quantities of nitrogen from the air. Their roots penetrate deeply into the subsoil, and they thus obtain plant food from depths beyond the reach of plants with smaller root development.

(3) Their manurial value. When the crop is fed, most of the nitrogen, phosphoric acid, potash, and other fertilizing ingredients go into the excrement, liquid and solid, and if preserved make a rich manure. If the crop is plowed under its plant food, including that acquired from the air and gathered from the subsoil, becomes available for succeeding crops. The large amounts of plant food left behind in roots and stubble after the removal of the crop furnish a cheap and valuable store of plant food for following crops.

While the clovers will doubtless prove in the future, as they have in the past, the most valuable of the legumes for general purposes in Connecticut, the cow-pea, soja bean and vetches are valuable for forage, silage, or hay, and the experiments and observations at the station and elsewhere indicate that they are worthy of careful trial.

Illinois Station, Bulletin No. 9, May, 1890 (pp. 40).

MILK AND BUTTER TESTS, A. G. MANNS, PH. D. (pp. 289–302).

Composition of milk.—Numerous analyses were made by the Short method. They bring out the wide variations in the proportions of fat in the milk of different breeds, of different herds, and of the individual cows of the same herd, even when receiving like feed, and illustrate the importance of using some accurate method of determining the quantity of fat in milk bought and sold for butter making.

Milk of different herds.—Of the milk furnished by two patrons to the same factory, on the same day, both being mixed milk from large herds,

one contained 3.07 and the other 4.75 per cent of fat. The average per cent of fat found in the milk furnished by sixty-three patrons of the DeKalb factory was 3.83; in that from sixty patrons of the Malta factory, 3.70; and in that from sixty one patrons of the Shabbona factory, 3.66. The average of fat as shown by 101 tests made of 35,017 pounds of milk furnished by these one hundred and eighty-four patrons was 3.73 per cent, showing that in large quantities of milk the tendency is to approach the average composition.

Milk of different cows of the same herd.—In the milk of a herd of sixty-four cows which "had been selected and bred with more than average intelligence, the average per cent of fat found was 4.21; the highest, 5.85; the lowest, 2.75—a variation of 3.10 per cent. The average of ten cows was 5.41; of ten others, 3.2. Dividing the herd into four equal lots, the average of one lot of sixteen was 5.18; of another lot of the same number, 3.38."

Milk from different breeds.—Analyses were made by the chemist of this station of milk from prize cows competing at the Chicago Stock and Dairy Show in 1889. The milk of three Holsteins averaged 3.17 per cent of fat; of two Ayrshires, 4.04 per cent, and of three Jerseys, 5.26 per cent. The first prize was awarded to a Holstein cow, giving in one day 65 pounds 7 ounces of milk, containing 3.45 per cent of fat.

The analyses illustrate anew and in a striking manner the importance of testing the milk of individual cows in a herd. They also emphasize the facts that the variation in milk of different cows may be greater than that of different herds, and that the larger the herd the greater is the tendency of the mixed milk to approach the average composition.

Composition of butter.—While chemical analysis can not determine with certainty the comparative excellence of two samples of butter, the determination of the composition of what is considered good butter in American markets is of interest. "By co-operation of the Illinois State Board of Agriculture and the Association of American Agricultural Colleges and Experiment Stations, five samples were taken by Drs. Babcock and Manns, chemists of the Wisconsin and Illinois Experiment Stations, from each of nine lots of butter to which first prizes had been awarded, in as many classes, at the American Dairy Show, held in Chicago, in November, 1889, under the auspices of the Illinois State Board of Agriculture." Samples were analyzed by five chemists, of whom Dr. Manns was one. The report of the committee of the Association of Colleges and Stations is printed in this bulletin. The prize samples averaged 85.74 per cent of fat, 10.23 per cent of water, 3.05 per cent of ash, and 0.96 per cent of curd. An analysis of creamery butter from Connecticut by E. H. Farrington, assistant chemist of the station, is also given.

Milk tests: Determination of percentages of fat.—The use of cream tubes and optical methods in determining the fat in milk are discussed and the sources of error pointed out. Short's method and the lacto-

scope were compared with the gravimetric method. Considerable trouble was experienced in securing flasks with uniform necks for the Short method, the variations in the flasks being su fficient to make differences of from 1 to 1.45 per cent in the results of the fat determinations. The results indicated by the lactoscope were variable throughout, while those obtained with the Short test agreed very well with the gravimetric, the greatest variation being 0.23 per cent of fat. "Neither the lactoscope nor the Short method are reliable in testing skim-milk."

Churn test as compared with Short test.—The object of the experiments was to test the practicability and fairness of paying for milk according to its actual butter value as indicated by the Short method. Tables show the percentages of butter fat found by Short's method in eighty-eight lots of mixed milk, and a comparison in seventeen samples of the weights of butter fat as calculated from the percentages found by Short's method with the weights of salted butter obtained by churning. With three exceptions the weight of butter actually obtained with the churn was slightly more than that of the total butter fat indicated by the Short test. On the average 101.4 pounds of butter were obtained for every 100 pounds of fat in the milk as indicated by the Short method. The author concludes that Short's method is trustworthy, provided the tubes necessary in its use have been properly made and graduated, and that it could be used as a test in paying for milk on the basis of its actual value for butter making.

Churning tests with cream of different degrees of acidity.—These trials were made for the purpose of testing the effect of acidity developed in the ripening of the cream upon the quantity and quality of butter. "For the purpose of locating the cause of the variations in the butter yield the cream was examined daily during the latter days of the series of trials just mentioned." It was found that although the conditions of temperature and concentration of the cream remained practically constant, the amount of acid developed during the ripening process varied considerably. Where the per cent of acidity was lowest, there the yield of butter from churning fell below that indicated by the Short test, otherwise it was higher. Of the three cases above referred to in which the butter yield fell below the fat, as determined by Short's test, two came in the days when the acidity of the cream was tested, and in both the quantity of acid was small. In a series of twenty-two subsequent trials the method of procedure was as follows: In all the trials the cream was thoroughly mixed, divided into two equal parts by weight, and allowed to ripen slowly under like conditions of temperature. Tests of the acidity of the cream were made just before churning. While one half was churned as soon as ripened, the other half was allowed to stand until it had become strongly acid before churning. The term "per cent of acidity" is used empirically, as "the lactic acid equivalent of the amount of alkali necessary to bring about a neutral reaction in 50 cubic centimeters of cream."

A tabular statement of the yields of butter from cream of different degrees of acidity shows that in general as the acidity of the cream increased up to a certain point, the amount of butter increased also, but increase of acidity beyond this did not increase the butter yield and did bring risk of injury to the quality of the butter. The yield of butter from the strongly acid cream was (in twenty cases) from 1.09 to 18.28 per cent higher than that from cream which was churned as soon as it had ripened; in the remaining two cases the yield from the just-ripened cream was 0.34 and 1.92 per cent more than from strongly acid cream. Increasing the acidity by adding small quantities of acetic acid to the just ripened cream before churning seemed to produce no beneficial effects. "The analyses of the buttermilk and of the butter from each churning showed that, in general, there was more fat left in the buttermilk from the just-ripened than in that from the acid cream, and that the quality of butter from the latter was superior to that obtained from the corresponding portion that had been churned with a smaller per cent of acid." The time required for churning the strongly acid cream was, in general, a little less than that for the other. "A different fermentation set in after the cream passed a certain point in ripening, which was highly detrimental to the quality of the butter."

Sweet vs. sour cream.—This trial with two samples of cream was made to test the method proposed by Professor Myers of the West Virginia Station, according to which the cream is to be churned without ripening and the fat in the sweet-cream buttermilk is to be recovered by means of a centrifugal machine. "The cream was divided into two portions. One half was churned sweet at a temperature of 55° Fah., while the second half was allowed to ripen, when it was churned at 60° Fah. The yield of the sweet-cream churning was but little below that of the ripened cream;" thus, in one case 4.19 pounds of butter were churned from the sweet cream, and 4.38 pounds from a like quantity of the same cream after souring; and in the second case, 4.22 pounds from sweet, and 4.35 pounds from sour cream. The author states that no fat could be recovered from the sweet cream buttermilk by means of the separator.

THE COMPARATIVE VALUE OF CORN FODDER AND SILAGE IN FEEDING YEARLING HEIFERS, T. F. HUNT, B. S. (pp. 302–314).—"The experiment was conducted with a view to determining, so far as one experiment may, the comparative values of corn (stalk and ear) when field cured, for corn fodder, and when made into silage, for producing increase of live weight in cattle."

For this purpose eight yearling heifers, all thoroughbred Shorthorns except one, a grade Shorthorn, were used. "They were a thrifty and fairly even bunch, well adapted to the work in hand except possibly in age and consequent lack of size." They were divided into two lots: lot 1, heifers 1 to 4, receiving field-cured corn fodder, and lot 2, heifers 5 to 8, receiving silage, in addition to hay and grain, of which both lots received the same. For two weeks previous to the beginning of the experiment,

while the animals were becoming accustomed to their quarters, they were given daily 6 pounds of middlings each and one feed of both corn fodder and silage.

The actual experiment continued from January 6 to March 31, 1890, eighty-four days. During this time each pair of heifers received daily 4 pounds of clover hay, and each heifer 6 pounds of crushed oats and all the silage or corn fodder it would eat, though with this full feeding more or less of the coarser parts of the silage or corn fodder were rejected. From January 6 to January 30 (first period) lot 1 received corn fodder from Burrill and Whitman silage corn, and lot 2 silage from the same corn. From January 30 to March 10 (second period) lot 1 was fed corn fodder from Burr's White corn, and lot 2 silage from the same. From March 10 to March 31 (third period) both lots received corn fodder from Burr's White corn, the supply of silage being exhausted.

The corn of the fodder and silage fed during the first period was less mature than that fed during the second and third periods. The corn fodder, which had been cut and left standing in shocks in the field, was hauled from the field twice a week and cut up in the same manner as the green corn had been in preparing it for the silo.

The animals were weighed daily throughout the experiment, and every precaution was used to have the weights taken under similar conditions each day. "They ate with reasonable regularity, made good gains, and were throughout the test in the best of health. Yet the table of individual weights shows striking daily variations. An average increase of 25 pounds per animal in one day, and again a decrease of 20 pounds may be noted." It is apparent that a comparison of particular days might be misleading. For this reason it was decided to take the average weight of five days preceding the beginning and ending of a given period in calculating the gain or loss for that period. The results are summarized in the following table:

Corn fodder and silage actually eaten, and observed gains in live weight for each period and during the entire experiment.

		Lot I. Corn fodder.				Lot II: Silage.			
		No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.
		Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs*	*Lbs.*
Period I, 24 days.	Total corn fodder or silage	164.00	219.5	188.5	144.75	625.0	572.25	619.75	496.25
	Total gain in weight. ...	46.8	38.0	58.0	43.4	56.2	70.8	72.7	59.8
Period II, 39 days.	Total corn fodder or silage	347.75	370 0	377.0	270.0	976.75	882.25	1156 0	833.75
	Total gain in weight.	87.4	80.2	72.2	45.8	69.8	58.0	68.6	54.6
Periods I and II, 63 days.	Total corn fodder or silage	511.75	589.5	565.5	414.75	1601.75	1454.5	1775.75	1330.0
	Total gain in weight... ..	134.2	118.2	130.2	89.2	126.0	128.8	141.3	114.4
		Lot I: Corn fodder.				Lot II: Corn fodder.			
Period III, 21 days.	Total corn fodder or silage.	171.5	199.25	184.75	152.75	154.25	190.25	189.25	161.5
	Total gain in weight	12.4	18.2	23.0	39.6	—14*	30.0	—7.4*	31.2
Total gain during experiment, 84 days.		146.8	136.4	153.2	128.8	112.0	158 8	133.9	145.6

* Loss.

In estimating the water-free substance consumed by each animal it was assumed, during the first period, that the quantity eaten contained the same percentage of water as that rejected by the animals and weighed back. This was found to involve an error, as will be seen by reference to Mr. Farrington's analyses beyond. In the second and third periods, therefore, the dry matter actually consumed was calculated by determining the water-free substance in the feed given and in the rejected portion, and subtracting the latter from the former. "The percentage of waste in feeding both corn fodder and silage is less than is indicated by the percentage of fresh substance not eaten." The results are tabulated herewith.

Dry matter actually eaten per pound of increase in live weight.

		Dry matter consumed.		Average gain per animal for period.	Dry matter consumed per pound of increase in live weight.
		Daily average per animal.	Total for period per animal.		
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Period I, 24 days..	Lot I. Corn fodder	11 28	270.7	46.6	5.82
	Lot II: Silage	12 87	308 9	64.9	4 76
Period II, 39 days ..	Lot I: Corn fodder	13.4	522.2	71.4	7.31
	Lot II · Silage	13 9	540.2	62 8	8.60
Periods I and II, 63 days	Lot I. Corn fodder	12.6	792 9	118.0	6.72
	Lot II. Silage	13.5	849.1	127.7	6.65
Period III, 21 days	Lot I: Corn fodder	13 2	278 0	23.3	11.93
	Lot II. Corn fodder	13.2	276.6	10.0	27.60
Total for periods I, II, III, 84 days	Lot I: Corn fodder	12.8	1,070.9	141.3	7.58
	Lot II: Silage and corn fodder	13.4	1,125.7	137.7	8.17

During the first period, twenty-four days, the heifers fed silage ate 38.2 pounds more of dry matter per animal than the lot fed corn fodder; but they gained 18.3 pounds more in live weight each than the corn-fodder lot, making the amount of dry matter consumed per pound of increase in live weight nearly 1 pound less in the case of the silage lot. In the second period the advantage would seem to have been slightly in favor of the lot fed corn fodder, for they ate 18 pounds less of dry matter per animal, gained 8.6 pounds more in live weight each, and consumed 1.3 pounds less of dry matter for every pound of increase made than the lot fed silage. Taking the two periods together, however, during the sixty-three days the silage-fed lot gained 9.6 pounds more in live weight, for which they ate 56 pounds more of dry matter per animal than the corn-fodder lot; the amount of dry matter consumed per pound of increase in live weight averaged practically the same for both lots.

During the third period the heifers previously fed corn fodder did better than those which had previously been fed silage, and which now received corn fodder. The latter fell off in weight considerably, there being in the case of two animals a total loss in live weight for the whole period.

How much of the observed increase or decrease in live weight is actually gain or loss in flesh and how much is due to changes in the weight of contents of the alimentary canal or to bodily disturbances caused by change in diet, it is impossible to say. According to the detailed tabular statement of the amounts of water drunk and in the food from February 17 to March 2, the heifers fed silage had in all about 7 pounds more water daily than those fed corn fodder.

Taking the whole experiment into account, the total gain in live weight of the two lots as shown by the scales was practically the same; but the heifers fed corn fodder required for every 100 pounds of increase 759 pounds of water-free substance; and the heifers which were fed silage during the first two periods and corn fodder the third period required 817 pounds of water-free substance for every 100 pounds of increase. Thus the heifers fed silage during the first two periods and corn fodder the third required more dry matter to make a pound of increase than those fed corn fodder the whole time. In brief, as indicated by the scales, the gain in weight per pound of dry matter of feed was in favor of the silage in the first period and of corn fodder in the second; so that at the end of the second period, the results with the two were about equal. In the third period, however, when the silage-fed lot changed to corn fodder, the difference was decidedly in favor of the corn-fodder-fed lot.

For this apparent superiority of the corn fodder three possible explanations are suggested by the author. (1) As shown by analyses by Mr. Farrington (see beyond), the character of the protein in the corn had been changed in ensiling, so that the albuminoid protein had been reduced 33 per cent in the silage. (2) "About 7 pounds more water were consumed daily by each heifer fed silage than those fed corn fodder." The elimination of this by the excretory organs, including the skin (evaporation), may have been done at the expense of the energy of the food. (3) It may be that, as suggested by Weiske, the silage passes more rapidly through the bowels and is less completely digested. "The relative digestibility of the field-cured and silage fodders, however, is still unsettled."

[It will be recalled that for the sixty-three days of the first two periods when silage was actually compared with corn fodder the fodder-fed lot gained 472 and the silage-fed lot 511 pounds, while the gain per pound of dry matter of food was practically the same; that is to say, the silage-fed animals ate more dry matter and gained proportionally in weight. But in the third period of twenty-one days the lot accustomed to corn fodder gained 93 pounds, while the lot changed from silage to fodder gained only 40 pounds. Whether and how far this apparent advantage in favor of the corn fodder was due to the inferior effect of silage, or to change of diet, or to differences in weight of contents of the alimentary canal which may occur even with the same diet, it is scarcely possible to say.]

ANALYSES OF CORN FODDER AND SILAGE. E. H. FARRINGTON, M. S. (pp. 315–319).—These analyses were made in connection with the above-described feeding experiment with heifers. "Duplicate samples of silage and of corn fodder were taken for analysis at five and six different dates respectively; also, samples of the refused corn fodder and silage from the night and morning feed at two different dates." The analyses, including a comparison of the albuminoid and non-albuminoid protein in the same, form an interesting feature of the bulletin, and the averages of all the results obtained are given in the following table:

	Water.	Dry matter.						
		Ash.	Crude fiber.	Crude protein.	Albuminoids.	Non albuminoids.	Crude fat	Non nitrogenous extract.
	Per cent.	Per cent	Per cent	Per cent.	Per cent.	Per cent.	Per cent.	Per cent
Corn fodder								
As fed	32.19	5.15	20.00	8.50	7.87	0.63	3.07	63.28
Refused	51.65	8.20	35.73	6.19	5.00	1.19	2.26	47.62
Corn silage:								
As fed	72.30	5.58	21.70	8.31	5.37	2.94	3.48	60.93
Refused	78.32	9.03	34.86	8.37	5.00	3.37	1.53	46.21

The corn fodder and silage not eaten, or refused by the animals, was principally the coarser stalks; a comparison of the water-free substance shows that what was refused contained more water, ash, and crude fiber, but less nitrogen-free extract and crude fat than the original feeding stuff. The per cent of protein is considerably less in the refused than in the original corn fodder, while the silage left uneaten contained nearly the same amount as the original. This suggests that either the nitrogenous constituents are diffused through the silage more evenly than in the corn fodder or that the animals ate the silage without selecting or picking over very much.

The relation of albuminoids to non-albuminoids is nearly the same in the refused as in the original silage, although quite different in the two kinds of corn fodder.

Especial attention is called to the importance of proper sampling and analyses are given of duplicate samples of corn fodder and silage, and the portions of the same rejected by animals, which show the variations in the composition of samples of different size.

In the following table the digestible coefficients used are, for corn fodder and silage, those given by Armsby;* for clover, hay, and oats, those given by Wolff. For explanation of the figures for potential energy (fuel value), see the bulletin, and Experiment Station Record, Vol. I, p. 268.

Digestible nutrients and potential energy in 100 pounds of material.

	Corn fodder as fed.	Corn fodder refused.	Corn silage as fed.	Corn silage refused.	Clover hay.	Crushed oats.
Digestible crude protein ....pounds..	2.53	1.29	0.94	0.73	8.14	8.26
Digestible crude fiber.... ......do....	9.62	12.27	3.61	4.53	......	....
Digestible crude fat ....do....	1.65	0.86	0.82	0.28	1.63	3.94
Digestible non-nitrogenous extract, pounds	29.18	15.69	10.68	16.61	37.07	44.85
Total digestible matter, pounds.	42.98	30.11	16.05	12.15	46.84	57.05
Nutritive ratio	1:16	1.23	1:17	1:16	1:5	1:6.5
Potential energies; Calories..........	83.841	58.039	31.779	23.261	91.018	115.420

* Pennsylvania Station, Bulletin No. 9.

Value of pasturage and of grain ration with pasturage for young cattle, G. E. Morrow, M. A. (pp. 319–325).—The questions proposed were: (1) The value of pasture for young cattle. (2) The value of a grain ration for young cattle on pasture. The observations here reported are based on two seasons' experiments, in 1888 and 1889. The trials were on good, dark-colored prairie soil. The field used was a "blue-grass" pasture, with some white clover, and had been in pasture for ten years.

Series of 1888.—Eight young steers, varying in age from eight to fourteen months, were divided into two lots, as nearly equal in weight as possible. May 14 they were all turned out, lot 1 into a 3-acre pasture, receiving no other feed; and lot 2 into a 2-acre pasture, receiving, from May 28, in addition to the grass, a grain ration consisting of a mixture of 12 parts of corn, 10 of oats, and 5 of grain, and varying in amount from 3.5 to 8 pounds per animal daily. "It was assumed that the steers receiving a liberal grain ration might safely have the acreage of pasture reduced one third, and the appearance of the two fields indicated that this assumption was fairly correct." The steers were all taken from the pasture October 29, and were fed during the winter on grain, hay, and corn silage. A table gives the weights of each lot, taken at intervals of two weeks, and the amounts of grain, hay, and silage fed each lot. The following season, 1889, the eight steers were pastured together in a 10-acre field.

Series of 1889.—Six steers, pure or grade Shorthorn, varying in age from a little less than one year to twenty months, were divided into two lots of three each, and on May 20 placed in the two pastures used in 1888. Lot 3 was in the 3-acre field without grain, and lot 4 in the 2 acre field, and, beginning with May 27, received, in addition to the pasture grass, from 5.4 to 10 pounds of shelled corn, or its equivalent of corn on the ear, per head per day. June 10 two Poland-China pigs were turned into the 2 acre field with lot 4 and received no other food than grass and the offal from the steers. The experiment continued through the season until November 25, though from October 14 both lots received corn. The amounts of corn fed to each lot, the weights of each lot at intervals of usually two weeks, and the calculated gains in weight are given in a table.

Gain from pasture alone.—The periodical gains in live weight of the individual animals varied remarkably, especially in the case of those receiving no grain. Thus, in 1888, lot 1 in the 3-acre pasture gained from May 14 to June 25, 400 pounds; during the next eight weeks only 70 pounds; during the next six weeks, 269 pounds; and during the following four weeks ending October 29 they lost 145 pounds. In 1889 the three steers in the same pasture (lot 3) gained from August 5 to August 19 (two weeks) 104 pounds, and during the two weeks following lost 1 pound in weight. The eight two-year-old steers used in the 1888–89 experiment gained on the 10 acres of pasture from April 29 to

June 24 (eight weeks) 1,130 pounds, and during the thirteen weeks following only 252 pounds. "Some reasons for these variations are obvious, but it is difficult to explain all of them. Except during October, 1888, the pastures did not appear to be grazed unusually short at any time. In the earlier part of each season the supply of grass was apparently more than the cattle needed. It seems evident, however, that they were too heavily stocked, taking the seasons as a whole. In no case was there a satisfactory gain per animal for the summer's grazing."

The results of trials in former years are cited where gains were made by yearling steers between May 1 and November 1 of from 225 to 420 pounds each, and by 2-year-old steers of from 280 to 466 pounds in the same length of time. "The gains per acre of grass land were more satisfactory than the gains per animal." The 3 acre pasture supported in 1888 four steers, which from May 14 to October 1 made a total gain in weight of 739 pounds, or 246 pounds per acre, and in 1889 three steers, which from May 20 to September 24 made a total gain of 617 pounds, or 206 pounds per acre. "With cattle selling at a reasonable price any of these gains would give a good return for the use of the land; especially as pasturage is one of the least exhaustive uses to which we can put our lands."

Gain from pasture and grain.—The grain-fed steers made a more uniform gain than those on pasture alone. In 1888 the four steers on the 2 acres of grass with grain gained from May 14 to October 1 only 39 pounds more than the four on 3 acres of grass with no grain. "That is, there was a gain of 39 pounds in weight, a saving of 1 acre of pasturage, and an undetermined increase in the value of the manure to offset the value of the 2,864 pounds of grain fed and the increase of labor made necessary by this feeding. Evidently the grain was fed at a loss in this case." In 1889 the steers receiving grain, on the same 2 acres of pasture, gained from May 27 to September 24, 130 pounds more than the three on the 3-acre pasture with no grain. The two pigs running with the grain-fed steers increased 129.5 pounds in weight during this period. "With beef and pork selling at average prices, this increased gain and the rental value of 1 acre of land would about equal the value of the corn fed. No considerable difference was found in the rate of gain in the two lots of steers in the autumn months when both were fed grain. In two cases the advantage was with the lots which had received no grain during the summer; in the third case the grain-fed steers made slightly larger gain in autumn than those which had had pasture only."

Similar experiments are to be made in 1890.

The questions to be solved are more complex than appears at first statement. Thus, evidently cattle with a grain ration will eat less grass; but how much less? The droppings of the grain-fed cattle will be more valuable as manure; but how much more? A better result will be secured if hogs follow the grain-fed cattle; but in what number? Aside from such questions as these, correct answers to which can not

be given in advance of repeated experiments, the obvious difficulties in making the results in one season apply to a season of a different character, or those from one pasture apply to a different pasture, make the results of two years' trials only suggestive.

The author suggests, however, the following conclusions, which, it is to be remembered, are based on existing conditions in Illinois:

The results from two years' trials indicate that a grain ration to young steers on good pasture is not usually profitable; the value of the increase in weight of the grain-fed steers over that of those having grass only will rarely repay the cost of food and labor. The increased value of the animals from earlier maturity and better quality may make the grain feeding profitable. Especially if the grain given be unground is it essential to have pigs follow the cattle if a profit is to be had. The acreage of pasture may probably be safely decreased one third if the steers be given a full grain ration. An acre of good grass may be expected to support a steer weighing from 800 to 1,000 pounds, and enable it to make a moderate gain during the summer. The addition of grain or other food to the pasturage before the grass fails in the autumn is clearly advisable. It is doubtful if at present in most parts of Illinois, cattle can be maintained or an increase of weight be secured at so low a cost in any other way as by allowing them to get all their food during the best of the grazing season from good pastures, fully but not overstocked.

EXPERIMENTS IN PROGRESS (pp. 326, 327).—In addition to the above reported tests, the bulletin contains a list of the experiments in progress at the station, references being given to the reports on these experiments already published.

Illinois Station, Bulletin No. 10, August, 1890 (pp. 8).

INVESTIGATIONS OF MILK TESTS, E. H. FARRINGTON, M. S.—The objects of the investigations were (1) to show the differences in the butter fat in milk from different cows and the consequent variations in the value of cows to their owners, some being kept at a loss, others at a profit; (2) to show that the weight of the milk brought to the creamery by a patron "is not the most accurate basis upon which to pay for the milk, since the butter fat, which alone is of value to the creamery, is not always proportionate to the quantity of milk"; (3) a trial of some of the simple and inexpensive methods of testing milk, and observations on the accuracy of determinations by these methods.

(1) *The value of cows as dependent upon amount and composition of milk.*—To show the wide difference in the amounts of butter fat in the milk of different cows and the importance to the farmer of knowing the quality of each cow's milk, determinations were made of the percentages of fat in the milk of individual cows on three different farms. The results stated in a table represent a record of one milking from each of thirty-eight cows, which were from twenty months to fifteen years old and from fourteen to four hundred and twenty-six days from calving, and at the time of the test were on pasture feed. The breeds represented were Holstein, Devon, Shorthorn, Jersey, Polled Angus, mostly grades, and natives. The percentages of fat ranged from 2.3 to 6 per cent, and the total fat from the milking ranged from 0.1 to 0.76 pounds.

Although the results are somewhat limited, it is stated that this is only the beginning of a work to be more extensively followed up.

If we compare Nos. 2, 3, 22, and 8 [the time since last calf being in each case two hundred and forty days] we find that No. 2 produced twice as much butter fat as No. 3, and nearly five and one half times as much butter fat as No. 8, and that No. 22 produced seven and one half times as much butter fat as No. 8.

Comparing No. 13 with No. 14 shows that nearly twice as much milk must be handled by the owner to get the same weight of butter fat from No. 14 as from No. 13. Besides these extreme cases mentioned, cows can be found all along the line from very profitable to very unprofitable.

(2) *Variations in the milk supplied to creameries by different patrons.*—Tests were made of the milk brought by one hundred and thirteen patrons to two creameries on the same day. The results, stated in a table, show the percentages of fat in the milk, the pounds of milk per pound of fat, pounds of fat in the milk, and pounds of milk. The milk supplied by two patrons of creamery A contained 3 and 3.1 per cent of fat each, and that from seven patrons 4 to 4.4 per cent, "making a difference of 1.4 per cent between the highest and the lowest," that is to say "the richest milk was 47 per cent richer than the poorest." The pounds of milk per pound of fat, in the milk from fifty-five patrons, ranged from 22.7 to 33.3 pounds and averaged 27.3 pounds.

Equally striking illustrations could be drawn from the record of creamery B. Eighty per cent of the patrons supplied milk ranging from 3.2 to 3.8 per cent of fat, but the milk brought by one patron ran as low as 2.3 per cent, and that brought by another as high as 4.6 per cent of fat; that is, one contained just twice as much butter fat in 100 pounds of milk. If the richer milk is received at $1 per 100 pounds, for the poorer but 50 cents per 100 pounds should be paid.

Trials of milk tests.—The methods of Short, Cochran, Patrick, Failyer and Willard, and Parsons are briefly described, and the results of analyses by the first three as compared with those by the gravimetric (on sand and on paper) are tabulated. On the whole the comparison was very favorable for the quick methods, the results rarely being more than 0.2 above or below the gravimetric, and the average difference very small. The determinations of fat in buttermilk were somewhat less satisfactory than those in whole and skim-milk. Observations are given on the kinds and cost of re-agents used, approximate time required for analyses and precautions necessary to accuracy. It is stated that with the Cochran method a single determination could be made in a half hour, or twenty-four analyses in one and one fourth hours, and at a cost of about one half cent for re-agents per determination; and with the Patrick method a single determination in about twenty minutes, or six determinations in a half hour, the cost of chemicals at the figures given being about 1 cent per determination.

Outside of the correct graduation of the measuring parts of the apparatus, the accuracy of the results obtained by using such methods as these, depends, to a controlling degree, on constant attention to such small details as measuring the fat in clean glass, and carefully and uniformly reading and recording the length of the fat col-

umn. * * * The divisions on the tube that the fat occupies should be read after it has stood at least fifteen minutes in water at a temperature of 140° Fah. (60° C.).

With Cochran's method a separation of the fat from buttermilk is nearly always obtained. The separation by Patrick's process is greatly helped by boiling the milk and acid somewhat longer than usual, adding about 5 cubic centimeters of ether when the mixture is cool, and then bringing it to a boil by heating gradually till the ether is all evaporated.

Cochran's and Patrick's methods especially commend themselves by the rapidity and ease with which the details can be comprehended and a sample of milk analyzed by almost any careful person, though not accustomed to such work. With each method, directions for using it are given; but any one wishing practical instruction in manipulation and use of the apparatus, may find it to his advantage to visit the laboratory of this station, where an opportunity will be given him for instruction in the process.

Iowa Station, Bulletin No. 10, August, 1890 (pp. 50).

OUR RUSTED AND BLIGHTED WHEAT, OATS, AND BARLEY IN 1890, R. P. SPEER (pp. 391–400).—An account of cereal crops grown at the station, with observations on rust, blight, and yields, discussion of causes of the falling off in yields during recent years, and recommendations of crops to be substituted for those now grown in Iowa.

In 1888 we sowed many kinds of oats, wheat, and barley, but all of them were so much injured by rust that they were scarcely worth harvesting. In 1889 we sowed them again, and a considerable number of them proved productive, and showed no signs of disease, while others suffered severely from rust, although the growing season was much more favorable for such crops than the preceding one. In 1890 we discarded certain varieties which had proved unreliable and procured others that were promising.

This year (1890) there were sown at the station thirty varieties of oats on March 26, and three on April 17; nine varieties of spring wheat and eight of barley on March 26, 27, and 28.

On many of the hottest days of June and July there were high, drying winds from the south and southwest, which were very unfavorable to all kinds of crops. All the varieties were severely injured by wet and blight, except French Hybrid and Velvet Chaff Blue Stem wheat, Mansbury barley, and Improved American and Everett oats. The three varieties of oats sown April 17 suffered more than the others. On July 12 I examined oat fields carefully on twenty-four farms in Story County, and found all of them more or less rusted; but the best oats were found where the seeding was done very early last spring in unplowed corn-stalk fields with two-horse cultivators.

Seven varieties of winter wheat were sown in the fall of 1889.

No rust appeared on the winter wheats until about the 28th day of June, when they were so nearly ripe that it injured them but little. They were harvested on July 3, when I estimated the yield of the Turkish wheat at 24, the Golden Cross at 20, and the other kinds at from 12 to 15 bushels per acre. For the purpose of determining what varieties are most productive, least liable to suffer from rust, or to be blown down and injured by storms, we have grown a large number of kinds of oats, wheat, and barley, where they were exposed to the same and very different surrounding conditions for three years. From such experiments on the college farm, and many others which I have conducted on my own farm during the last twenty-five years, I have drawn conclusions which I will give below with the facts on which they are

based. From 1850 until 1870, oats and spring wheat were injured but little by fungous diseases or insects, and it was but seldom that they did not produce good crops; but, from the latter date until now they have been unreliable and unprofitable. The average yield of oats in Iowa for the last ten years has been 33 bushels per acre and the average price has not exceeded 20 cents per bushel, which would give the farmers $6.60 for the product of each acre. But the general rule in all parts of the State has been for renters to give one third of the oats after being threshed for the use of land, which would leave only $4.40 per acre for plowing, seed oats, seeding, harvesting, stacking, and threshing. As spring wheat has not paid any better than oats, it is not remarkable that many farms are mortgaged and that many farmers are complaining of hard times.

The decline in the yield of oats and wheat in Iowa is attributed to the destruction of the wild prairie grasses, which formerly shaded the soil and kept it moist.

By breaking up the prairies and stirring the soil frequently, we destroyed the innumerable little clods, grass roots, and root spaces, which formed a sufficient number of channels for the free admission of water and air. Instead of being shaded by a thick growth of grass, as it was formerly, a very large share of the State consists now of bare, hard pastures, which are constantly absorbing the heat of the sun, during the day-time, to drive out the limited supplies of moisture which they do contain.

When rains do come it is difficult for them to penetrate such soils, and the result is that a large part of the water runs off over the surface of the ground to the creeks and is lost. * * * It is useless for us to talk about planting forests to increase the rain-fall, but if a majority of the farmers of Iowa and the adjoining States would sow clover on a large scale and plant belts of forest-trees to break the force of the winds, we would grow much better crops of wheat, oats, barley, etc., than we have grown during the last twenty years. We should not forget, that wheat, oats, barley, etc., are never injured by rust where there are no great extremes of summer temperature and no severe spells of drought. Clover should be sown not only for what it would do for our climate, and other crops, but because there is more money in it than in any other crop which can be grown successfully in Iowa, except corn. Why not make clover one of our principal crops, instead of oats, which have failed oftener than they have proved profitable, on account of unfavorable climatic conditions? And why not substitute Manshury barley for oats? It is comparatively free from rust and blight in Iowa. It is very productive, has good, strong straw, yields more dollars' worth of digestible nutrients per acre in all kinds of seasons than oats, and as a nurse crop for clover it is much better than oats or spring wheat.

Calculations based on the amounts of digestible nutrients in different crops, and the average yields of these crops in Iowa, are given, to show the relatively high value of clover and barley.

The article concludes with the following summary:

From the frequent partial failures of our oat crops on account of rust, and the rapid deterioration of good varieties which we have imported from the best oat countries we can draw no other conclusion than that Iowa is not a good oat State. The results of our experiments have proved conclusively—

(1) That if we shall continue to grow oats, they should be sown as early in the spring as it is possible to cover them with cultivators, harrows, or seed drills; that the seed bed should be comparatively hard or compact (except 1 or 2 inches of soil on its surface), and that only such varieties as the Everett or the Improved American should be used for seed.

(2) That no other kind of barley is as valuable as the Manshury; that it should be sown very early, also; and that it is much more reliable and profitable than any variety of oats.

(3) That all varieties of spring wheat are unreliable in Iowa, and should be discarded on account of their liability to attacks of rust.

We can not speak positively in regard to winter wheat; but the results of our experiments indicate that the hardiest varieties may be grown successfully on well-drained soils if they are mulched sufficiently to prevent the ground from thawing during the first warm spells in the spring. There is no better mulch than a dense growth of wheat blades, which can be secured generally by sowing wheat about the 1st of September in the northern half of the State, and a little later farther south. The Turkish and Golden Cross are the most reliable varieties of winter wheat which we have tested.

EXPERIMENTS WITH ARSENITES, C. P. GILLETTE, M. S. (pp. 401–420).—This article is substantially the same as a paper read by the author before the Society for the Promotion of Agricultural Science, at Indianapolis, 1890. It includes a report on experiments made during the past two seasons, in which much attention was given to the finding of some method of applying the arsenites "so as to prevent injury to foliage without lessening their effectiveness in destroying insect life." There are also given results of experiments, the object of which was to observe the relative injuries to foliage from applications of the arsenites when freshly mixed and when allowed to stand a few days before being applied; the effects of adding paste or soap to arsenical mixtures; the effects of sun, dew, and rain upon foliage treated with arsenical mixtures; whether or not it is practicable and safe to mix the arsenites with insecticides that kill by external contact, and the effects of combining the arsenites with fungicides.

In these experiments more than one thousand applications were made, in most cases "to a few carefully selected twigs, bearing perfect foliage, where every leaf could be thoroughly treated. Most of the applications have been made with a bellows-sprayer or atomizer." Among sources of error apt to be overlooked in calculating the results of such experiments are noted the age of the leaves, injuries due to fungi, position and shape of the leaves, and effects of rain, dew, and sunlight.

Comparative injuries to foliage from London purple, Paris green, and white arsenic, when freshly mixed and applied in water.—Data for experiments on plum, apple, cherry, peach, alder, and poplar trees are recorded in a table.

It will be seen that in the proportion of 1 pound to 25 gallons the average injury from London purple has been 46, from Paris green 37, and from arsenic 8 per cent. In the proportion of 1 pound to 50 gallons, London purple has averaged 30, Paris green 30, and arsenic 1 per cent injury. In the proportion of 1 pound to 100 gallons, London purple has averaged 15, Paris green 9 per cent, and white arsenic no injury. In the proportion of 1 pound to 200 gallons, London purple has averaged 7, Paris green 3 per cent, and white arsenic no injury. It will also be noticed that different trees vary greatly in their power to resist the action of these poisons. In my experiments, alder and poplar have not been seriously injured by applications as strong as 1 pound to 25 gallons. Cherry has been less injured than apple, and apple less than plum, while peach has been most susceptible of injury of any plant to which the poisons were applied, a pound to 200 gallons in some cases destroying more than 50 per cent of the foliage.

Perhaps the most surprising thing set forth in the table is that pure white arsenic

applied to the foliage of plum, apple, and cherry has in no case done serious harm, unless stronger than 1 pound to 50 gallons, and the average injury to plum foliage, when applied in the proportion of 1 pound to 25 gallons, is less than 10 per cent.

Attention is called to the fact that these results do not agree with those reported in Bulletin No. 53 of the Michigan Station (See Experiment Station Record, Vol. I, p. 227).

Increased injuries to foliage from allowing the arsenites to remain in water for a time before being applied.—The tabulated data show that in the case of London purple the injuries were about the same as when this poison was applied in the ordinary way. "The water from Paris green, which is hardly at all soluble, did but slight harm in any case. Arsenic water did very serious harm. As dilute as 1 pound to 200 gallons it destroyed 90 per cent of plum foliage, and 25 per cent of cherry foliage."

Effects of adding paste to arsenites mixed in water.—"When treating plum-trees for the destruction of the plum curculio, in the spring of 1889, I used one half ounce of flour made in paste to each gallon of the mixture of London purple in water. So much injury was done to the foliage that it was thought best to determine whether or not the paste was in any measure accountable for it." The results of applications made for this purpose, as recorded in a table, indicate that the addition of paste materially increased the injury to foliage.

Soap added to arsenical mixtures.—"London purple, Paris green, and white arsenic were also applied to foliage in water that had been made slightly soapy, and considerable evidence of increased injury, as the result, was obtained. The applications were not repeated, and final conclusions can not be drawn."

Best time to apply arsenical mixtures.—As far as the experiments performed by the author are concerned, the time of day does not seem to affect the result of the application of arsenites, and rains occurring soon after such applications only lessen the injury to foliage.

Lime added to the arsenites to prevent injury to foliage.—The first experiment in which milk of lime was added to the arsenical mixtures was made in the fall of 1889. The results were so encouraging that similar experiments were made this year, the results of which are recorded in two tables. "The applications were made upon the foliage of plum, apple, cherry, peach, alder, locust, poplar, grape, and squash." The average percentages of injury from London purple and Paris green with and without lime were as follows:

	Proportion of arsenite to water.			
	1 pound to 25 gallons.	1 pound to 50 gallons.	1 pound to 100 gallons.	1 pound to 200 gallons.
London purple with lime	14	4	1	0
London purple without lime	56	31	17	9
Paris green with lime	16	5	3	3
Paris green without lime	43	35	11	4

In the case of white arsenic an opposite effect was produced. "It will be seen by referring to the table that the white arsenic did from three to twenty times as much damage when combined with lime as when the lime was left out."

Tabular data are also given for experiments with London purple and Paris green combined with rosin, soap, Bordeaux mixture, sulphate of copper, and carbonate of copper, respectively.

Conclusions.—The author divides his inferences into two classes: (1) those which he regards as well proven by the experiments, and (2) those requiring further investigations. In the first class are the following:

(1) The oldest leaves are most susceptible to injury from arsenical applications. They often turn yellow and drop without showing the burnt, spotted appearance.

(2) Dews, and probably direct sunlight, increase the injuries done by the arsenites to foliage.

(3) Leaves kept perfectly dry can hardly be injured by the arsenites, even when they are applied very abundantly.

(4) The only effect of a heavy rain or dashing shower following an application of one of the arsenites is to lessen the injury to foliage.

(5) When freshly mixed and applied, London purple is most and white arsenic is least injurious to foliage.

(6) White arsenic in solution should not be used upon foliage without first adding lime, Bordeaux mixture, or some other substance to prevent its injurious effects upon foliage.

(7) White arsenic, if allowed to stand many days in water before being applied, will do far greater harm to foliage than if applied as soon as mixed.

(8) Lime added to London purple or Paris green in water greatly lessens the injury that these poisons would otherwise do to foliage.

(9) Lime added to a mixture of white arsenic in water will greatly increase the injury that this poison would otherwise do to foliage. If the arsenic is all in solution, the lime will then lessen the injury, as in the case of London purple or Paris green.

(10) London purple (Paris green and white arsenic have not yet been tried) can be used at least eight or ten times as strong without injury to foliage if applied in common Bordeaux mixture instead of water.

(11) The arsenites can not by any ordinary method be successfully mixed in a kerosene emulsion.

(12) London purple in sulphate-of-copper solution does vastly more harm than when applied in water only.

The following are the doubtful conclusions:

(1) Applications made in the heat of the day and in the bright sunlight do not injure foliage more than when applied in the cool of the day.

(2) Leaves suffering from a fungous disease are more susceptible to injury than are healthy leaves.

(3) The arsenites mix readily in rosin compounds and do not seem to be more injurious to foliage than as ordinarily applied in water.

(4) The arsenites in strong soapy mixtures do considerably more harm to foliage than when applied in water only.

(5) The arsenites mix readily in carbonate-of-copper solution and do not seem to do more harm than when applied in water only.

STOCKS FOR THE CHERRY, PLUM, PRUNE, AND APRICOT, J. L. BUDD, M. H. (pp. 421–430).

The cherry.—Attention is called to the fact that though the Mahaleb stock is extensively used, practical fruit growers hold the most diverse

views regarding its value. Experiments by the author are cited to show that there is no complete union of the cherry with this stock, especially in the case of the varieties having colored juice.

At present we are compelled to use the Mahaleb as a stock for some of the pale-juiced varieties that make a fairly good union with it, but we are arranging to secure a better root for all varieties, as the Mahaleb is not suited to all soils. On ordinary black prairie drift it soon perishes, and the tree dies if not rooted from the scion.

Experience at the station is favorable to the Mazzard and Morello stocks, and the experimental use of the native stocks of the wild red cherry (*Prunus pennsylvanica*) and sand cherry (*Prunus pumila*) is advised.

The plum.—The Myrobalan or Cherry plum, Black Damas, and St. Julian stocks having proved unsatisfactory in the West, the use of the typical form of the native *Prunus americana* is advised. This should be distinguished from the small red variety, which is worthless for this purpose.

The prune.—"We have at least two valuable prunes. The Black prune of Russia is hardy enough to endure the most trying seasons in any part of the State, and the large and fine Hungarian prune will prove profitable in the southern half of the State. These also do best on our native plum stocks."

The apricot.—"The Myrobalan and St. Julian stocks have been mainly used in propagating the named varieties of the Russian apricots, and the Chinese variety, known as Shense in Iowa and Acme in Nebraska." Experiments at the station, however, indicate that these stocks do not unite with the apricot. "Thus far our experience and observation favor the use of our native plum as a stock for the apricot. Our trees on this root are yet young but the union is good and we believe the trees will be durable."

Stone fruits on their own roots.—Experiments with Russian cherry-trees now in progress at the station are referred to in support of the practice, widely adopted in Europe, of growing fruit-trees on their own roots. The methods of propagating fruit-trees from root cuttings are briefly described.

A CHEMICAL STUDY OF BLUE-GRASS, C. M. WADE, B. S. (pp. 431–437).—In view of the fact that blue-grass is being largely grown in Iowa for pasturage and hay a series of chemical analyses of this plant were made by the author on samples collected at different stages of growth from the college campus. The results are stated in a table.

The conclusions were: (1) that since the nitrogen-free extract and crude fiber increase from the first, and albuminoids diminish, the nutritive value of the grass is highest when it is very young, and runs down rapidly as the grass develops; (2) that until bloom the gain in dry matter and the growth of the plant counteract the loss in per cent of nutritive constituents; (3) that after blooming the grass loses value through an increase of fiber and a decrease of carbohydrates, which probably become fiber; however, it is believed that at this period the grass suffers more through a loss of digestibility and palatability.

Analyses of blue-grass hay by the author as compared with those of timothy, redtop, orchard grass, and "low meadow hay," compiled from reports of the Connecticut Station, show that the blue-grass hay analyzed was "much richer in protein than the timothy or orchard grass, and somewhat richer than redtop and low meadow hays. It also has another advantage in containing several per cent less of the indigestible crude fiber. In nitrogen-free extract it does not differ from redtop, but is somewhat lower than timothy."

The best time to cut blue-grass for hay is considered to be "about the time of early bloom or shortly afterward, for at that time the total amount of nutrients has reached its maximum and the digestibility has not been seriously impaired by the stalks becoming hard and woody."

CORN FODDER, R. P. SPEER (pp. 438–440).—To impress upon farmers the wastefulness of the practice of leaving corn fodder in the field, which is common in the West, calculations are given to show that corn fodder is as valuable as a feeding stuff as timothy hay, and that the yield per acre of the former in Iowa is greater than that of the latter. "We should also consider the facts that corn is well adapted to our climate and not liable to suffer from fungous diseases, while timothy crops are injured frequently by rust. Like timothy hay, corn fodder has a wide nutritive ratio and should be fed with wheat bran, oil-cake, or something which is rich in albuminoids."

A "cheap, simple, and practical contrivance for loading and unloading corn fodder" is described and illustrated. Its essential features are a post 6 or 7 feet long set up at the rear end of a hay-rick, and a pole about 20 feet long, attached near its middle to the top of the post after the manner of the old fashioned well-sweep.

Kansas Station, Bulletin No. 11, July, 1890 (pp. 14).

EXPERIMENTS WITH WHEAT (pp. 15–26).—"The experiments reported in this bulletin were planned and for the most part executed under the direction of Prof. E. M. Shelton, who resigned at the close of 1889." The general wheat crop grown in a field of about 14 acres of the college farm in 1889–90 averaged 30 bushels per acre. The variety used was Zimmerman.

Wheat continuously.—The yields are reported for a measured acre of upland, medium heavy loam planted in wheat continuously for ten years (1880–90). The yield in 1890 was 22.9 bushels, which is about one half bushel greater than the average yield for the ten years, including two seasons when the wheat was winter-killed.

Listed wheat.—A half acre of listed wheat in 1890 yielded at the rate of 35⅓ bushels per acre, while only 30 bushels per acre were produced on an adjoining drilled plat. In a previous experiment the listed wheat showed a tendency to lodge, but this was not the case this season, which was comparatively dry.

Wheat in rotation.—In the fall of 1889 twenty-five plats of one tenth acre each were laid out on clay-loam soil and an experiment begun which included wheat in alternation with oats, corn, and summer fallow, and wheat continuously, with 20 tons of barn-yard manure yearly and without manure. Each part of the experiment was repeated five times on as many plats. Zimmerman was the variety of wheat used. The results of the first season are reported in a table. "They are of interest only as showing the influence of the manure." The yield per acre on the manured plats averaged 40 bushels, while that on the unmanured plats was 35 bushels, showing an increase of only 5 bushels from the use of 20 tons of barn-yard manure per acre.

Wheat, test of varieties.—Tabulated and descriptive notes on 19 varieties of wheat which have been tested two years at the station.

Of this list, those varieties which have averaged 30 or more bushels during the past two years are the following: Currell 38, Zimmerman 33, Extra Early Oakley 31, and Red May 30.

The Currell is so far ahead of all others as to be strikingly conspicuous. It shows plainly the merits of certain varieties over others, and points out indirectly the importance of testing and comparing varieties in order to learn which are the best yielders, and to sift out the unprofitable ones. Although the heads of the Currell were short and slender, they had almost invariably three grains to a spikelet, and the grains were of uniform plumpness.

Kansas Station, Bulletin No. 12, August, 1890 (pp. 27).

PRELIMINARY EXPERIMENTS WITH FUNGICIDES FOR STINKING SMUT OF WHEAT, W. A. KELLERMAN, PH. D., AND W. T. SWINGLE, B. S. (pp. 27–51, illustrated).—This disease of wheat is briefly described. "No exact counts have been made in fields in Kansas, but in our experimental plats, planted November, 1889, with Kansas seed (untreated) the smut varied from 64 to 86 per cent." The growth of the fungi causing the disease, the mode of the infection of the host plant and the methods of prevention commonly employed are briefly described, with special mention of experiments with sulphate of copper and with hot water by J. L. Jensen, in Denmark. The two closely allied species of parasitic fungi causing the stinking smut are thus differentiated:

The one species (apparently the commoner in the West) is known to botanists as *Tilletia fœtens* (B. & C.), Schroet., and has rather regular sub-globose to elliptical spores, which are *smooth walled* and 15 to 22 by 15 to 20μ in diameter. The other species, known as *Tilletia tritici* (Bjerkander), Winter, has regular globose spores, which have a wall *marked with net-like ridges*, and are 16 to 20μ (mostly 17μ) in diameter.

Both species occur in Kansas and were found on the experimental plats at the station this year. These should be distinguished from the loose-smut fungus (*Ustilago tritici*).

The loose smut is not confined to the grains (as the stinking smuts are), but attacks the whole head and converts it into a loose powdery mass of spores held together by a few shreds and plates of tissue. Moreover, the spores of the fungus causing the

loose smut are very much smaller and germinate in an entirely different manner from those of the two *Tilletias* (stinking smuts). A full account of loose smut is given in the Report of the Kansas Station for 1889, pp. 261-267. * * * The land used for the experiments reported in this bulletin was that occupied in 1888 and 1889 by oat smut experiments [See Kansas Station, Bulletin No. 8, Annual Report for 1889, and Experiment Station Record, Vol. I, p. 216], together with the land (adjoining the former on the east) occupied in 1889 by second year crossed corn (See Report of Kansas Station for 1889). The soil was a fairly good upland loam that had been under cultivation and manured (with stable manure) a few years before. [This field was divided into one hundred and two plats (as shown in a diagram), ranging in size from 30 to 220 square feet, and planted with smutted seed wheat November 4, 5, and 23, 1889.] Owing to the lateness of the planting, the seed germinated tardily and the plants grew very slowly. By January they were only 1 to 2 inches high. It is probably due largely to this slow growth that the amount of smut was so large. For it is in the highest degree probable that if the seedlings grow very slowly their tissues remain liable to infection a longer time.

Fifty-one different methods of treating the smut were tried on as many different plats, the alternate plats remaining untreated. Lye, hot water, copper sulphate, Bordeaux mixture, eau celeste, sodium hyposulphite, potassium sulphide, arsenic, lime, salt, Castile soap, cistern water, chloroform, sulphurous oxide, carbon bisulphide, ether, ammonium hydrate, carbolic acid, sodium carbonate and bicarbonate, potassium bichromate, mercuric chloride, salicylic acid, and sodium sulphate were used in different forms and applied for different lengths of time. The results as indicated by the yields of smutted and sound grain on both the treated and untreated plats, are stated in a table, and those on a number of plats are illustrated by a diagram.

Three of these treatments, viz.:

Copper sulphate 5 per cent solution, twenty-four hours; Bordeaux mixture, thirty six hours; potassium bichromate 5 per cent solution, twenty hours, prevented all the smut, though all injured the stand of the wheat somewhat. However, in spite of this injury they increased the yield to two or three times that of untreated plats.

Besides the above favorable treatments, six others, viz.: hot water 131 to 132° Fah., fifteen minutes, skimmed; hot water 132 to 131° Fah., fifteen minutes; copper sulphate 8 per cent solution, twenty-four hours; copper sulphate 8 per cent solution, twenty-four hours, limed; Bordeaux mixture, half strength, thirty-six hours; copper sulphate one half per cent solution, twenty-four hours, gave less than 1 per cent smutted heads, and from two to three times the amount of grain obtained from untreated plats.

Plat 45, treated with a saturated solution of arsenic twenty-four hours, gave only 1.09 per cent of smutted heads and a yield more than two and one half times that of the adjacent untreated plats. The following treatments: sodium hyposulphite, 10 per cent solution, twenty-four hours, limed: potassium sulphide, 2 ounces to 6 gallons of water, twenty-four hours, limed; arsenic and lime, mixture of equal parts saturated solution of each, twenty-four hours; salt, saturated solution diluted one half, thirty-six hours, gave per cents of smut varying from 4.27 to 21.04. The yield exceeded that of the adjacent untreated plats two to two and one half times. The per cent of smut, though only a small fraction of that in untreated plats, reduces the value of the treatments.

[The other treatments either produced little effect on the smut or were destructive to the grain.]

Of all the treatments tested, the Jensen, or hot-water method, is probably the best

for general use, although in our experiments it did not prevent all the smut. However, in the most favorable form, only 5 heads out of 3,912 were smutted, and it is probable that these were accidental, since they grew from two hills on the edges of the plat.

The Jensen treatment, which consists in immersing the seed for a few minutes in scalding water, was the only one which destroyed the smut and left a full stand and the highest yield, with one slight exception. This method is described in detail.

The bulletin is illustrated with a plate showing smutted heads and sound and smutted grains of wheat.

Kansas Station, Bulletin No. 13, August, 1890 (pp. 30).

EXPERIMENTS WITH OATS, C. C. GEORGESON, M. S., AND H. M. COTTRELL, M. S. (pp. 53–80).—The high temperature and dry atmosphere characteristic of Kansas during the growing season prevent large yields of oats, even under the most favorable conditions. "There is, therefore, all the more reason for instituting careful and far-reaching experiments with this crop in order to ascertain, if possible, by what methods and from what varieties we may expect to obtain the best results."

The past season has been unusually dry, so that the yields of oats in the experiments reported in this bulletin are abnormally low. The following series of experiments were undertaken:

1. Methods of seeding. (1) On plowed *vs.* unplowed land: (*a*) listing, (*b*) drilling, (*c*) cultivating, (2) broadcasting on plowed land, (3) plowed under.
2. Character of seed: (*a*) light, (*b*) common, (*c*) heavy.
3. Single variety *vs.* a mixture of varieties.
4. Cultivation *vs.* no culture.
5. Harvesting at different stages of ripeness: (*a*) dough, (*b*) hard dough, (*c*) ripe.
6. Oats as a hay crop: (*a*) oats only, (*b*) oats and sorghum, (*c*) oats and millet.
7. Oats grown as single plants.
8. Test of eighty-five varieties.

All the experiments except the last were made on a dark clay-loam upland soil, which had been in corn the two previous years. Details are given in tables.

(1) *Methods of seeding.*—These experiments were on twentieth-acre plats, five plats being used in each trial, with one exception.

The following table shows the average yield of the several plats under each method of seeding, in bushels per acre:

Methods of seeding.	Land plowed.			Land not plowed.		
	Grain per acre	Straw per acre.	Straw per bushel grain.	Grain per acre.	Straw per acre.	Straw per bushel grain.
	Bushels.	*Pounds.*	*Pounds.*	*Bushels.*	*Pounds.*	*Pounds.*
Listed	24.75	868	35.0	27.15	855	31.5
Drilled	33.50	933	28.0	34.52	850	24.6
Cultivated in	24.56	990	40.3	29.55	904	33.6
Broadcasted	29.56	737	24.9	....	....	....
Plowed under	21.56	830	38.5	....	....	....

In every case the land which had not been plowed gave the best yield. Counting the cost of plowing at $1.25 per acre and oats at 35 cents per bushel, there was an actual gain per acre by not plowing the land of $2.09 in the case of listed oats, $1.60 for drilled, and $3 for those covered with cultivator. This indicates that oats prefer a moderately firm bed. In a loose soil, other things being equal, they run more to straw, apparently at the expense of the grain.

The best yield was obtained on the drilled plats, viz., at the rate of 33.5 bushels per acre, the broadcasted coming next with 29.5 bushels, then the listed and cultivated-in following closely upon each other with 24⅜ and 24¼ bushels, respectively, the lightest yield being from the plats covered with the plow, which average only 21¼ bushels per acre.

That the drilled oats should outyield the broadcasted is contrary to the results generally obtained in farm practice, and it is probably due, in part at least, to the peculiarities of the implement used [the rollers of which pressed firmly upon the soil, making a firm bed at the bottom of the drill, into which the seed was dropped.] The soil in which the seed roots is thus pressed firm, which is opposite to the workings of the ordinary hoe drill, and in view of the preference which oats have for a firm bed, this circumstance may be the cause of the favorable results obtained by the use of this drill.

(2) *Character of the seed.*—To throw light on the influence that the character of the seed has on the crop, three grades of Red Winter oats were selected, denominated, according to their weight per bushel, as "light," "common," and "heavy." Five one-twentieth-acre plats were devoted to each grade. * * * The "common seed" was taken from the oats as they came from the thresher, and weighed 28 pounds to the struck bushel. The other two grades were obtained by running the "common" oats through a fanning mill, which separated them into five grades. Of these we used the lightest and the heaviest, which weighed, respectively, 19 pounds and 32 pounds to the struck bushel. [The average yield in bushels per acre for each kind of seed was: "light," 21¼; "common," 24; "heavy," 30.]

This showing is interesting, although it proves only what is already well known. The heaviest seed yielded 6 bushels more per acre than the common seed oats taken (as is usually the case in practice) as they came from the thresher. On this basis the oat crop of Kansas could last year have been increased by 8,352,588 bushels if only selected heavy oats had been sown, worth at the average price of the crop (16 cents) $1,336,413, or twice that sum at the present price of oats. Select seed pays, and pays well.

(3) *Single variety vs. a mixture of varieties.*—On the theory that varieties differ in their needs and powers to assimilate the available nutrients from the soil it is often asserted that several varieties mixed together, with their roots feeding among each other, are supported better, and will make a larger growth on a given area than is possible with a single variety under the same conditions.

To get light on this matter, Red Winter, Badger Queen, and Virginia Winter oats were sown on twentieth-acre plats as follows: "Four plats were given to each of the three varieties, four to a mixture of all three together, and four to a mixture of the Red Winter and Badger Queen. The plats were distributed among each other so as to equalize possible inequalities in the soil."

The yield of Virginia Winter was very light. The average yield per acre of Red Winter and Badger Queen, grown singly and in mixture, were 29.3 and 31.2 bushels, or nearly 2 bushels in favor of the mixed seed. "The average of all three varieties grown singly is less than 21½ bushels per acre (21.46), whereas the average of a mixture of the three

is nearly 29 bushels per acre (28.8), giving us a gain of 6⅓ (6.34) bushels per acre in favor of the mixture.'

(4) *Cultivation vs. no culture.*—Red Winter oats were used on twelve twentieth-acre plats. "In this case cultivation occasioned a slight loss; the plats which were not cultivated averaged 31.9 bushels per acre, while the harrowed and hoed plats yielded, respectively, 28.8 and 28.2 bushels per acre. The loosening of the soil with hoe and harrow no doubt injured the roots near the surface."

(5) *Harvesting at different stages of ripening.*—It is sometimes asserted that oats ought to be cut before they are fully ripe, the advocates of this practice maintaining that there is a loss rather than a gain in the yield between the dough stage and ripeness. Another argument in favor of early cutting, to which every practical farmer will agree, is that oats cut before maturity are not so easily beaten out in handling. Fifteen plats were devoted to the investigation of this question. Five were harvested June 27, when the grain was in the "dough," five more June 30, when in the "hard dough" and the remaining five, July 5, when fully ripe.

There was a slight but constant increase in the yield from the dough state to ripeness, the "dough" series yielding 32.6, "hard dough" 33, and the ripe series 33.2 bushels per acre. [The weights per struck bushel of grain were 31.6, 31.8, and 33 pounds, respectively.] Thus there is no gain, but on the contrary a slight loss, by cutting them before they are ripe. On the other hand, there is a loss of weight in the straw with increased ripeness. This factor is, of course, subject to greater fluctuations than the grain, and in this case the figures giving the weight of straw may, therefore, not be of much value. It is evident that the more fully it is ripened the less water does it contain, and it is equally evident that the straw will make better fodder if cut before the starch and other carbonaceous bodies in the culm change to woody fiber in the process of maturing. The facts obtained indicate that if the straw is depended on for feed the oats should be cut early; but if the grain alone is wanted they should be allowed to mature. This is emphasized by the increased weight per struck bushel of the ripe grain.

(6) *Oats for forage.*—This experiment was undertaken with a view to obtain some definite data in regard to the amount of forage which may be obtained from oats on this soil, when these are sown thickly and harvested green, i. e. soon after the formation of the seed. Twelve plats of one twentieth acre each were seeded April 5, a rather late date for the best results. Six plats were seeded with 4 bushels per acre, and the remaining six plats with 2½ bushels of oats and half a bushel of either sorghum or millet.

The Virginia Winter oats were a failure in this as in the other experiments of this season, and the sorghum and millet did not make a satisfactory growth. "The Red Winter oats yielded 1¾ tons good hay per acre in three months from seeding, which is a very fair crop for this season."

(7) *Oats grown as single plants.*—The objects were to observe the growth of single plants and compare the grain with that grown in the ordinary way. As the experiments were spoiled by drought they are not reported in full.

(8) *Tests of varieties.*—Descriptive notes and tabulated data for eighty-five varieties. The highest yields were 50 bushels per acre with White Eureka, and 45 bushels each with Pedigree Red Rust Proof, Colorado Yellow, Probsteier, and Red Georgia.

Kentucky Station, Bulletin No. 28, May, 1890 (pp. 13).

EXPERIMENTS WITH FERTILIZERS ON TOBACCO, M. A. SCOVELL, M. S.—The object of the experiments was to study the questions as to (1) the effect of leading elements of plant food on the production of tobacco; (2) whether commercial fertilizers can be profitably used in raising tobacco on our soils; and (3) the forms and amounts in which nitrogen and potash should be applied for this crop. The soil used was a "blue-grass" soil, derived from the lower silurian limestone, rich in phosphoric acid, and considerably worn, having been in cultivation for many years. "The year previous to that in which the experiments with tobacco were made it was in oats. The land had never been fertilized except in the spring of 1888, when 100 pounds each of acid black [dissolved bone-black], muriate of potash, and nitrate of soda were mixed and sowed broadcast."

The effects of nitrogen, phosphoric acid, and potash on the production of tobacco.—Two series of experiments were made with similar purpose. The fertilizers used in both were the same as those recommended for soil tests at the conference of representatives of experiment stations in Washington, and printed in Circular No. 7 of this Office, except that sulphate of potash was used in place of muriate. Nitrate of soda 160 pounds, dissolved bone-black 320 pounds, and sulphate of potash 160 pounds per acre, were used singly, two by two, and all together on seven different plats, two plats remaining unmanured. The size of the plats was in experiment No. 1, one twentieth of an acre each; in No. 2 one fortieth of an acre. The fertilizers were applied broadcast just previous to setting the plants, which in both experiments were placed 22 inches apart in rows 3 feet wide. Tables give the total yields from the nine different plats in both experiments, carefully graded to "bright," "red," "lugs," "tips," and "trash." The largest total yield, and the best general yield, as far as quality was concerned, was, in the first experiment, with the complete fertilizer consisting of dissolved bone-black, sulphate of potash, and nitrate of soda, and in the second experiment with nitrate of soda. In both experiments the plats receiving nitrate of soda produced the largest yields of any plat on which a single ingredient was used; and the best general yield with any combination of two ingredients was with sulphate of potash and nitrate of soda. In both experiments the lowest yield, where fertilizers were applied, was where nitrate of soda and dissolved bone-black were used together, and the quality of the tobacco on these plants was little if any better and contained a higher percentage of "trash" than that from the unmanured plats. The yield with dissolved bone-black was in both instances the lowest of those where single ingredients were used. In general the application of fertilizers materially improved the quality of the tobacco.

Financial results.—In estimating the values of the crops from the two experiments just described the "bright" and "red" leaf were calculated

at 15, "lugs" at 6, "tips" at 8, and "trash" at 2 cents per pound. A table shows the results obtained, averaging the yields from the two experiments. In every instance where fertilizers were applied, except with the combination of nitrate of soda and dissolved bone-black, there was an increase over the crops from the unmanured plats. This increase calculated for 1 acre amounted to from $16.70 to $107.70. The best financial result was with the complete fertilizer; the second best with a combination of sulphate of potash and nitrate of soda; and the largest profit with any single ingredient, with nitrate of soda. A financial loss followed the use of nitrate of soda and dissolved bone-black in combination; and the smallest profit was with dissolved bone-black used alone.

In what form should nitrogen be applied?—On one of three plats nitrate of soda was applied at the rate of 160 pounds, on another sulphate of ammonia 120 pounds, and on another cotton-seed meal 340 pounds per acre, these different quantities furnishing the same amounts of nitrogen. The nitrogenous fertilizer was in each case combined with sulphate of potash 160 pounds, and dissolved bone-black 320 pounds per acre. From the table giving the yield of graded tobacco from each plat it would appear that a better quality and larger yield were produced with the combination containing nitrate of soda than with either of the other nitrogenous materials.

In what form should potash be applied.—Sulphate and muriate of potash, each at the rate of 160 pounds and of 320 pounds per acre, were compared on four plats, the potash salt being in each case mixed with 160 pounds of nitrate of soda and 320 pounds of dissolved bone-black per acre. The total yield of tobacco was in both trials considerably larger where muriate of potash was used, and the tabular statement of the graded crops seems to indicate that, contrary to the general belief, the quality of the product was also superior where muriate was applied. Thus, calculated on the basis of valuation given above, in the first trial the yield with muriate was worth per acre $227.90, and with sulphate $213.80; and in the second trial, with muriate, $212.90, and with sulphate $154.10.

Amount of nitrogen required per acre.—Six plats were used. Nitrate of soda at the rate of 160 pounds per acre, sulphate of ammonia 120 pounds per acre, and cotton-seed meal 340 pounds per acre in three cases and double these amounts in three other cases, were added to a mixture of sulphate of potash 160 pounds and dissolved bone-black 320 pounds per acre. "From the results obtained it would seem that 160 pounds of nitrate of soda or 340 pounds of cotton-seed meal would furnish nitrogen in sufficient quantities for the crop, while it would take rather more than 120 pounds of sulphate of ammonia."

Amount of potash fertilizer required per acre.—The four plats used in the experiment to determine what form of potash should be applied, were also used to answer this question.

"It would appear from these results that rather more than 160 pounds of either sulphate or muriate of potash would be beneficial to the tobacco crop."

The author's conclusions from the year's experience are:

(1) That commercial fertilizers materially increase the yield and improve the quality of Burley tobacco.

(2) That the increase is obtained whether potash, phosphoric acid or nitrogen are used separately or in various combinations.

(3) That potash and nitrogen in combination seem to be required to produce the best results.

(4) That there is a handsome profit by using fertilizers in the best combinations.

(5) That the effect was [nearly] the same whether potash was used in the form of muriate or sulphate.

(6) That nitrogen in the form of nitrate of soda seemed to produce the best results as to quality.

Kentucky Station, Bulletin No. 29, July, 1890 (pp. 16).

COMMERCIAL FERTILIZERS, M. A. SCOVELL, M. S.—This contains popular accounts of common fertilizing materials, explanations of fertilizer analyses and valuations, brief directions regarding the application of fertilizers, and the tabulated results of analyses of ten brands of raw-bone manures, and fifty-four brands of complete fertilizers, superphosphates, etc.

Kentucky Station, Bulletin No. 30, August, 1890 (pp. 20).

EXPERIMENTS WITH WHEAT, M. A. SCOVELL, M. S., AND C. L. CURTIS (pp. 3–16).—These were a continuation of the experiments reported in Bulletin No. 21 of this station (See Experiment Station Record, Vol. I, p. 218). They included tests of varieties, methods of seeding and fertilizers, and were conducted on the station farm, which is in the Blue-Grass region, and has a light clay subsoil, retentive, and without proper drainage. The farm is, therefore, not especially adapted to wheat.

Test of varieties (pp. 3–7).—A tabular record of tests of twenty-nine varieties is given, including data for the season of growth, the yields per acre of grain and straw in 1890, and the yields of grain per acre in 1889 and 1890. The plats used comprised one fiftieth of an acre each. "A severe freeze on March 6 seriously damaged the crop. Some of the varieties, as Extra Early Oakley, were almost entirely destroyed. * * * From the two years' results it would appear that German Emperor and Hunter's White are especially worthy of trial by farmers, while many others are almost equally as good."

Methods of seeding (pp. 7, 8).—A brief tabular record for the second of a series of experiments with different methods of seeding. The season was of such a character as to render the experiment inconclusive.

Field experiments with fertilizers on wheat (pp. 8-11).—The general plan of this experiment was the same as that on the same field last year. Dissolved bone-black, "acid black" (320 pounds per acre), muriate of potash (160 pounds), dried blood (160 pounds), singly, two by two, and all three together, were compared with each other and with cotton-seed-hull ashes (400 pounds) on one plat, two plats being left unmanured. The results as given in a table are similar to those of last year and indicate that "this soil did not need fertilizers for wheat."

Co operative experiments (pp. 12-16).—Brief reports are given from a number of farmers who tested varieties of wheat and the effects of fertilizers sent them by the station.

A NEW WHEAT FLY, H. GARMAN (pp. 16-20, illustrated).—The author thinks that he has identified as *Oscinis variabilis*, Loew., a small fly which he found in a grub state infesting wheat in Fayette County, Kentucky.

In structure and habit, as far as I have observed the latter, it proves so like the European species that it might perhaps be appropriately named the American frit fly. It was common last fall on young wheat and especially so on that growing where the wheat shocks had stood in the summer. The central blades of infested plants generally have the central leaf dead and brown, and when the green outer blades are stripped off the cavity within them is found to contain only the dead tissue of the plant, and refuse in which the author of the injury—a small yellowish white grub—generally occurs.

The insect in its different stages is described and illustrated. It was observed most abundantly on volunteer plants, which should be destroyed in the fall and winter on account of this and other pests which they harbor.

Maryland Station, Bulletin No. 6, September, 1889 (pp. 79).

COMMERCIAL FERTILIZERS, H. E. ALVORD, C. E., AND H. J. PATTERSON, B. S. (pp. 71-147).—In the introduction it is stated that "Maryland is more deeply concerned in the subject of commercial fertilizers than any other State in the Union."

Ten years ago the farmers of Maryland were paying nearly $3,000,000 ($2,838,465) for fertilizers. This enormous expenditure was exceeded by only two States—Pennsylvania, with 200,000 farms, and Georgia, with 140,000 farms—while Maryland had only 40,000 farms. Maryland spent in 1879 over $70 for manures, for every farm within her borders; no other State averaged $50 per farm, and but one even half as much as Maryland. This State paid out 85 cents for fertilizers for every acre of improved land in farms; New Jersey alone approached this amount. But the worst showing was the relation of expenditures for fertilizers to the total annual income from the farms; for every $100 received in Maryland during the last census year for agricultural products of every description, $9.84 was expended for commercial fertilizers—almost a tenth part of the entire income of the farmers of the State.

This expenditure is no doubt relatively less at the present time in Maryland and the other States than it was ten years ago, but it is still a heavy tax on agriculture. More than forty years ago the Maryland

legislature authorized the appointment of a State agricultural chemist. His reports contain much valuable information relative to the use of fertilizers, but since these publications are not available at present a compilation of general facts on this subject has been made in this bulletin. A brief history is given of the introduction of commercial fertilizers; the composition of soils and plants, the way in which fertilizers become available as plant food, the important elements of plant food, and the principal fertilizing materials and their sources are explained; the average composition of fertilizing materials is stated in a table compiled mainly from the reports of the Massachusetts State Station; advice is given regarding the selection, purchase, and use of fertilizers; the relative advantages of home-mixed and factory fertilizers are discussed; directions and formulas for home mixing are given; the composition of ten common farm crops is compared with that of ten brands of commercial fertilizers, by means of a table and diagram; the question whether the continuous application of phosphoric acid injures the land by making it sour is discussed at considerable length; the advantages of laws for fertilizer inspection, the history of such legislation in Maryland, and the State law now in force are explained; and the full text of the law, which was approved April 3, 1890, is given.

Home mixing.—This has been strongly advocated and is considerably practiced. Some of its advantages are the following: The buyer gets exactly what he prefers to use, in the way of fertilizing materials; he is (perhaps) surer of getting unadulterated articles than if mixed goods were bought; the plant food can be found in concentrated form, and expense and labor saved in freight and hauling to the farm; the cost of the factory work is saved, or rather replaced by the farm labor; the home-mixed fertilizer can be varied in composition, in any quantity, to suit the wants of a particular field or crop. On a tight barn floor, or on an earth floor under cover if smooth, hard, and dry, different fertilizing materials can be mixed just as well as at the factory, if time and care are given to the work. The tools needed are platform scales, a shovel, and an iron hand rake or light hoe; sometimes a sand screen is useful also. The reducing of bones and rock phosphate to superphosphate on the farm has been recommended, but this is very questionable advice. The process is not so simple as is represented, and concentrated sulphuric acid, or oil of vitriol, which must be bought, transported, and used in considerable quantity, is a decidedly dangerous thing to handle for persons unfamiliar with it. Home mixing had better stop short of superphosphate making, and be confined to the compounding of materials needing no further chemical treatment. The mechanical part of it alone is comparatively simple.

Factory fertilizers, on the other hand, are generally, as a matter of fact, more even in composition and much better in mechanical condition than where the same ingredients are mixed on the farm. At the factory the work is usually done with the aid of specially devised and labor-saving machinery, managed by skilled and experienced workmen. Add to these advantages the economy of handling large quantities at a time, and it is probably true, as claimed, that the manufacturer can do the work at less cost, bags included, than the farmer who employs the cheapest of day labor. Moreover, if cheap hand-labor is used for this work, unless closely supervised, at additional cost, the home mixing is liable to be very poorly done. Where factory fertilizers are bought, the price should be from $2.50 to $3 per ton more than the unmixed ingredients of which they are made, in the same market; this represents the average cost of mixing and re-bagging.

Home-made superphosphates.—It is at times convenient to reduce to a condition suit-

able for use as a fertilizer the animal bones which accumulate about a farm, or may be bought cheaply at a neighboring village. A simple method of doing this without the use of acid is as follows: Crush the bones as thoroughly as possible and provide a barrel of fresh-burned lime and three barrels of strong, unleached hard wood ashes for every barrel of crushed bone. Use as a base, or mixing hearth, a tight floor, or a level layer of loamy soil about 6 inches thick. Upon this spread a barrel of ashes, in a similar layer. Then, in a thinner layer, half a barrel of bone; scatter through the bone, to fill the spaces, and spread upon it half a barrel of lime, pulverized, but not slaked. On this spread a second barrel of ashes. Wet this pile gradually with a sprinkler, using about 10 gallons of water, or enough to moisten all, but have none run out. Add in like manner a half barrel of bone, a half barrel of lime, a barrel of ashes, and 10 gallons more of water. Over all scatter about 1 bushel of land plaster, and cover the entire pile with dry loam. Examine the pile once a week, and add water, if needed, to keep all moist, but not wet. In four or five weeks shovel over and thoroughly mix, moisten, and pile again, cover with soil and a little more plaster, and leave two or three weeks longer. If pieces of bone then remain undecomposed, sift them out to use in next compost, or add more quicklime and ashes and give further time.

Continuous use of phosphoric acid.—The lesson taught by the facts and considerations given in the bulletin seems to be—

To keep on using phosphates, and acid phosphates, in generous quantity without apprehension. Yet, if phosphates are largely used through a series of years, the time may come when the soil holds not only a surplus of phosphoric acid, but so much as to be superfluous. This will be plainly shown in practice by the failure of further applications of phosphate to produce an effect. If this condition is reached it should be promptly observed; then phosphatic applications should be entirely omitted for a time. And potash, lime, and very likely nitrogen, will then prove profitable, to make more available and effective the surplus store of phosphoric acid.

A single line of investigation now in progress but far from conclusive, indicates that the long-continued use of acid phosphates upon light, sandy lands may be injurious by changing the physical character of the soil, rendering it looser and more sandy. It may be that some qualification of the foregoing statements will become necessary, but present knowledge of the subject justifies only this brief allusion to it. The whole field of soil physics is comparatively unexplored, but is receiving more and more attention. From studies in that line much may be expected of practical value, bearing directly upon tiliage and the application of manures and fertilizers.

Digest of Maryland fertilizer law of 1890.—The term commercial fertilizer is made to include any article, substance, or mixture for manurial purposes, of which the selling price shall be more than $10 per ton. Every inspector, manufacturer, manipulator, dealer, or agent is required to take out a license, issued from the 1st of May of each year, for the sale of fertilizers, the license fee being $5 for the first 100 tons or less, and $3 for each additional 100 tons. In case more than the amount allowed for by the license is sold, $5 is to be paid for each 100 tons of the excess.

Every package or lot of fertilizer must be accompanied by a statement showing the net pounds of fertilizer in the package or lot; the name under which the fertilizer is sold; the name and address of the importer, manufacturer, or manipulator; the place of manufacture or manipulation; and a chemical analysis stating only the minimum per cent of nitrogen or its equivalent in available ammonia, potash soluble in

distilled water, and available phosphoric acid which the fertilizer contains. Each importer, manufacturer, or manipulator is required to send a sealed sample of not less than 2 pounds of each brand of fertilizer to the Maryland Agricultural College. Failure to comply with these provisions of the law is punishable by a fine of $100 for the first offense and $200 for each subsequent offense. All sellers of fertilizers are required to send lists of the brands they have for sale to the college under penalty of $25 for the first failure so to do and $50 for each subsequent offense. The college is required to analyze free of charge all samples of fertilizers sent to it by purchasers and to procure and analyze samples of all brands sold in the State each year. The reports of these analyses must be accompanied by commercial valuations. These analyses are to be paid for out of the fund accruing from fees for fertilizer licenses, but the college is not to receive more than $3,000 for this purpose in a a single year. In case of fraud committed by the seller, the purchaser may recover an amount equal to the purchase money and costs of the suit. For adulteration or misbranding of fertilizers the penalty is fine and imprisonment, not to exceed $200 for the former and six months for the latter.

Massachusetts State Station, Bulletin No. 37, July, 1890 (pp. 16).

METEOROLOGY (p. 1).—Summary for the four months ending June 30, 1890.

FEEDING EXPERIMENTS WITH LAMBS, C. A. GOESSMANN, PH. D. (pp. 1–8).—These experiments are the first of a series devised for the purpose of ascertaining the cost of feed when fattening lambs for the meat market by means of winter fodder rations. Six lambs, five Hampshire Down and one Merino, all grades—three ewes and three wethers—were divided into two lots of three animals each to compare the relative financial effects of wide and narrow rations. The experiment with lot 1, which had the more nitrogenous ration, continued from September 5 to February 4, one hundred and fifty-two days; and that with lot 2, which had the wider ration (containing less protein and more carbohydrates than that of lot 1), from September 5 to March 18, one hundred and ninety-four days, the lower rate of increase in the weight of the animals and the condition of the local markets causing the extension of the test in the latter case. For ten days preceding the trial both lots were fed rowen hay exclusively. Beginning September 16 both lots received alike the coarse fodder consisting of rowen hay, silage, or rowen and silage together, and in addition grain, consisting in the case of lot 1, of a mixture of wheat bran and gluten meal in different proportions and amounts in different periods, the nutritive ratio of the rations varying from 1:4.5 to 1:5.5; and in the case of lot 2, during the same one hundred and fifty-two days, of a mixture of corn meal, wheat bran, and gluten meal, the nutritive ratio of the rations varying from

1:6.99 to 1:7.3. From February 4 to March 18 lot 2 was fed rations having a nutritive ratio of 1:5.7.

The quantity of food, details regarding which will be stated in the next annual report of the station, was regulated by the appetite of each animal. The dressed mutton was sold at 11 cents per pound, the wool at 22 cents per pound, and the pelts at 12½ cents each. A tabulated statement of the live weight and wool produced by each lot during the experiment, and the financial results follows:

	Total weight of lot at—		Gain in live weight during experiment, including wool, per lot	Average loss by dressing, exclusive of wool.	Total amount of wool produced per lot.	Financial statement.	
	Beginning of experiment.	End of experiment.				First cost of lambs and feed per lot	Receipts for mutton, wool, and pelts, and estimated value of manure.
	Pounds.	*Pounds.*	*Pounds*	*Per cent.*	*Lb. oz*		
Lot 1, 152 days	215.75	323 25	107 50	44 3	12 5	$22 85	$28.55
Lot 2, 194 days	212 50	298 50	86 25	46.3	12 4	22 09	25 17

The cost of feeding is based on rowen at $15, corn silage at $2.75, corn meal at $19, wheat bran at $17, and gluten meal at $23 per ton. In estimating the value of the manure it was assumed that 80 per cent of the valuable fertilizing ingredients of the food would be recovered in the manure, and these ingredients were reckoned at prices paid for them in commercial fertilizers. "Sheep are known to produce one of the best home-made manures."

The figures show that lot 2 on the wider ration did so poorly for one hundred and fifty-two days that even with a narrower ration during about forty days more their total increase in live weight was less, the per cent of shrinkage in slaughtering was larger, and the amount of wool produced practically the same, as compared with lot 1 in one hundred and fifty-two days of feeding on the richer ration.

Among the conclusions drawn by the author from the experiment are: (1) that for the fattening of lambs a ration rich in digestible nitrogenous constituents was clearly superior; (2) that "corn silage as a substitute in part for rowen gave very satisfactory results"; (3) that the profit was derived from the value of the manure, which is calculated to be for lot 1, $5.67 (profit $5.70), and for lot 2, $4.49 (profit $3.08).

ANALYSES OF FEEDING STUFFS AND FERTILIZERS, C. A. GOESSMANN, PH. D. (pp. 9, 10).—This includes analyses of wheat middlings, oat feed, and gluten meal, with determinations of fertilizing ingredients, and analyses of wood ashes, dry ground fish, ground bones, muriate of potash, sulphate of potash, saltpeter waste, jute waste, hen manure, an animal fertilizer, and twenty-two commercial fertilizers, the last having been made in connection with the Massachusetts fertilizer inspection.

Massachusetts Hatch Station, Bulletin No. 9, May, 1890 (pp. 47).

SOIL TESTS WITH FERTILIZERS, W. P. BROOKS, B. S.—This is a report of a series of co-operative field experiments with fertilizers applied to corn on eight farms in seven different counties in Massachusetts, to test the special needs of soils. The plan adopted by the conference of experiment station representatives at Washington in March, 1889, and published in Circular No. 7 of this Office, is closely followed. A circular letter was sent to the presidents of ten of the county agricultural societies of the State, explaining the purpose and general plan of the local soil tests proposed, and inviting the co-operation of the society. The replies received were all favorable, and several of the presidents addressed offered to conduct the experiments themselves. Care was used in the selection of experimenters, and in every case except two a personal inspection was made of the land by one of the station staff before its acceptance for the trial. The fifteen twentieth-acre plats used in each trial were long and narrow, with intervening strips, making the total area 1 acre. Nitrate of soda at the rate of 160 pounds per acre, furnishing 24 pounds of nitrogen, superphosphate (dissolved bone-black) at the rate of 320 pounds, furnishing 69 pounds of available phosphoric acid, and muriate of potash at the rate of 160 pounds, furnishing 72 pounds of "actual potash," were used, each by itself, on three plats, two by two on three plats, and all together in a "complete fertilizer" on one plat. Sulphate of lime (plaster) at the rate of 160 pounds, lime at the rate of 160 pounds, and barn-yard manure at the rate of 5 untrodden cords per acre were used singly on three plats, while five plats were left unmanured. The commercial fertilizers were supplied by the station. Analyses were made of these, and in nearly every case of the barn-yard manure. The fertilizers were in all cases applied broadcast to plowed land and harrowed in just previous to planting. The selection of seed was left to the individual experimenters, in all cases a variety of yellow dent corn being used. The rows were 3½ feet apart, and the planting generally in hills. Each experimenter was furnished with maximum and minimum registering thermometers and a rain-gauge. Each field was visited twice during the season by a representative from the station, and the harvesting and weighing of crops was done in the presence of a station assistant.

Each of the eight experiments, including one made on the station grounds, is reported by itself, and details are given of yields of hard and soft corn and stover in pounds per plat and per acre; gain or loss as compared with unfertilized plats; results of measurements of height of corn at different times during the season; summary of observations of temperature and rain-fall; results of the addition of nitrogen, phosphoric acid, potash, complete fertilizer, barn-yard manure, land plaster,

and lime, assuming the difference in yield to be due to the fertilizers applied; and finally the "value of the net increment due to fertilizers," and the financial results.

The two chief difficulties experienced were richness, and unevenness in fertility of the soil. The effects of disturbing conditions, including "the remains of former manure piles," were such that in only two cases was the land "tolerably even in fertility." This unevenness is strikingly illustrated by the yields of the unmanured plats in the same field. Thus on one field, a fine gravelly loam, the greater part of which had been in grass and unmanured for ten years (though "a small portion had been cultivated within five years, receiving but little manure, and since that time had been in grass and unmanured"), the yield of corn on the five unfertilized plats was at the rate of 19.8, 11.5, 16.9, 23.2, and 8.7 bushels per acre, respectively; and in another instance, on a soil "composed of very fine sand," which "had never received much manure, was cultivated last seven years ago and had subsequently been used as a pasture," the unmanured plats yielded, respectively, at the rate of 49.6, 41.8, 49.1, 27.6, and 32.1 bushels per acre.

That the eight different soils tested differed very widely from one another in natural fertility is evident from the fact that the average yields of shelled corn on the five unmanured plats of each experiment, calculated for 1 acre, varied from 6 to 50 bushels, and of stover from 550 to 2,836 pounds, the average yield on the 40 unfertilized plats in the trial being 26.3 bushels of shelled corn per acre.

The results seem to indicate that on three of the soils tested, potash was the element most needed, and on one phosphoric acid, while in four cases the results were not pronounced enough to be conclusive; in every case except one the increase of shelled corn over the yield from unmanured plats was larger with barn-yard manure than with the complete fertilizer, and in six instances this increase was larger with barn-yard manure than with any other fertilizing material.

It is evident that the indecisive results of several of these experiments were due to the character of the soils rather than to any defects in either the planning or executing of the work. The following general conclusions are warranted by the details given.

(1) The results of our experiments bring out in a striking manner the fact that soils vary widely in their requirements; * * * that results obtained in one locality may be inapplicable in another; and appear to establish the wisdom of the policy of local soil tests.

(2) It is evident that only when the farmer knows what his soil requires can he produce the best economical results. It is folly to continue the indiscriminate and blind use of fertilizers.

(3) The best method of ascertaining what is needed in any given case to produce a particular crop is to put the question to the soil itself; and this method, though requiring care at all points and caution in forming conclusions, is not, in reality, difficult. Such experiments should abundantly repay the investigator in the practical money value of the results.

Massachusetts Hatch Station, Bulletin No. 10, October, 1890 (pp. 14).

SPECIAL FERTILIZERS FOR GREENHOUSE CROPS, S. T. MAYNARD, B. S. (pp. 3-7).—"The question of the use of special fertilizers under glass is becoming one of great importance and is attracting much attention among practical gardeners and scientific men." This article is a preliminary report on a series of experiments in this line begun in the winter of 1888-89 and conducted "in two houses built side by side as nearly alike as possible, one heated with steam and the other with hot water [For accounts of these greenhouses and their heating, see Bulletins Nos. 4, 6, and 8 of this station, and Experiment Station Record, Vol. I, pp. 82 and 225; Vol. II, p. 104]. The space was divided into plats of equal size in each house with the same number and kind of plants in each." Muriate and sulphate of potash, sulphate of ammonia, nitrate of soda, and bone-black were used singly for carnations, lettuce, and tomatoes. An ordinary liquid manure was also used for carnations, and nitrate of potash for lettuce and tomatoes. Muriate and sulphate of potash were compared for pansies, and in another experiment with carnations ground bone and muriate or sulphate of potash were combined with one of the other fertilizers named above or with dried blood. In general it appeared that sulphate of ammonia gave the best results, especially in the production of foliage; bone-black increased the number of blossoms; the results with sulphate of potash were better than with muriate; and those with nitrate of potash were better than those with nitrate of soda.

INJURY TO PEACH BUDS, S. T. MAYNARD, B. S. (pp. 7, 8).—"In New England the great question to be solved in the cultivation of the peach is the protection of the buds from injury by the cold during the winter. To learn when the buds were destroyed, observations of their condition were made every week from December 1, 1889, to March 13, 1890, and at each observation five hundred buds were cut open and examined." December 28, 6 per cent of the buds examined were found to have been destroyed; February 1, 14 per cent, and March 7, after the thermometer had fallen to 6° below zero, 80 per cent. Efforts to find some means of protecting the buds against injury from the cold have thus far been unsuccessful, but investigations in this line will be continued.

SMALL FRUITS, S. T. MAYNARD, B. S. (pp. 8-14).—Tabulated notes on 49 varieties of strawberries, 82 of raspberries, and 16 of blackberries. "The strawberry crop for the past year was very variable, some varieties that gave great promise in previous seasons doing poorly, while many that gave little promise before were very good."

The author believes that a better crop of strawberries could be produced at less cost for thorough cultivation if the plants were grown in hills, and is conducting experiments with this method of planting.

The following varieties are especially commended: *Strawberries*—Augur's No. 70, Belmont, Bubach, Gandy, Haverland, Jessie, and Warfield; *raspberries*—Hansel, Marlboro, and Cuthbert; *blackberries*—Agawam, Erie, and Minnewaski.

Massachusetts Hatch Station, Meteorological Bulletins, Nos. 16–21 (pp. 4 each).

These include a daily and monthly summary of observations from April to September, 1890, inclusive, made at the meteorological observatory of the station, in charge of C. D. Warner.

Michigan Station, Bulletin No. 63, July, 1890 (pp. 27).

GREENHOUSE CONSTRUCTION AND HEATING, L. R. TAFT, M. S. (illustrated).—Two forcing-houses, each 50 by 20 feet, with suitable work-rooms, furnace rooms, etc., were recently built at this station. "As they were to be considered experimental forcing-houses, it was thought best to make them, so far as was possible, experimental in their construction, by combining in them various methods of glazing, heating, and ventilating." The methods of their construction, the ventilating machinery, furnaces, etc., are described in detail and illustrated with cuts. One house is heated with steam, the other with hot water. A test of the two methods of heating made from December, 1889, to April, 1890, inclusive, is reported, with daily records of the temperature outside and inside each house and of the coal consumed by each furnace.

The following shows the average temperature and amount of coal consumed daily in each of the houses during four months:

	Atmosphere.	Hot-water house, 6 a. m.	Steam house, 6 a. m.	Coal.	
				Water house.	Steam house.
				Pounds.	*Pounds.*
December	31.78	54.9	52.4	75.00	93.2
January	27	54.1	52.5	90.32	112.09
February	25.6	55.57	53.82	99.1	121.4
March	22.85	54.9	53.38	113.7	131.45
Average	26.81	54.87	53.02	94.53	114.53

This shows for nearly four months an average of 1.85° in favor of hot water, and a coal consumption in the steam heater 21.5 per cent greater.

"For the month of April the two systems were compared in a different manner. The same amounts of coal were supplied to each, with a resulting temperature, as will be seen by the table, in the hot-water house seven degrees higher than in the steam-heated house." For this month the average amount of coal used daily was 60 pounds, which produced an average temperature (as observed at 6 a. m.) of 58.4° in the hot-water house, and of 51.86° in the steam house. The average out-

side temperature at 6 a. m. was 36.2°. These results are in the same direction as those obtained at the Massachusetts Hatch Station.*

The following statements are taken from a summary given in the bulletin:

In the construction of forcing-houses for commercial purposes, we believe that the best results will be secured if the walls are built of grout (cement, sand, and cobblestones) below the surface of the outside soil, with the portion above the grading of wood, with from two to four thicknesses of boards, two of building paper, and an air space. If properly built, however, a wall entirely of grout will prove almost indestructible.

We should build the roof of permanent sash bars, and use glass at least 12 inches wide. The butting of the glass has given us entire satisfaction. The new method of glazing, in which a strip of wood is laid over the joints and held down by nails or screws, will make a tight roof.

Also, the tests thus far made indicate that hot-water heating is both more economical and more satisfactory than steam heating for small greenhouses. * * * The use of small wrought-iron pipes from 1¼ to 2 inches in diameter, according to the size of the house (a smaller size even might be preferable for the returns in a small house), will be found desirable. For most purposes the combined overhead and under-bench system seems better than to have all the pipes either overhead or under the benches. We have not made a test of overhead piping, but for houses for forcing cucumbers, etc., this system has given general satisfaction.

As the houses were built for experimental purposes, we shall be glad to utilize them in testing any new methods of glazing, or glazing materials. They also afford an opportunity of testing ventilating and other greenhouse machinery, heaters, methods of piping, etc.

Michigan Station, Bulletin No. 64, July, 1890 (pp. 11).

FERTILIZER ANALYSES, R. C. KEDZIE, M. D.—Analyses of forty-three commercial fertilizers, including six samples of bone, made in connection with the Michigan fertilizer inspection.

Minnesota Station, Bulletin No. 12, July, 1890 (pp. 16).

MEADOWS AND PASTURES IN MINNESOTA, W. M. HAYS, B. S. A. (pp. 119–124).—A summary of the results of observations made, and experience gained or confirmed at this station, with reference to the grasses and clovers best adapted to Minnesota, is published in this article as furnishing a fair basis for practice by farmers, and for further study by the station. A large quantity of seeds have been ordered from Russia for the experiments in this line.

We can not long depend upon our native grasses, as they do not thrive under cultivation, and none of the better of these wild varieties can be easily or cheaply seeded.

Rotation of crops; stock raising; a plentiful use of barn-yard manures; occasional crops, as of grain, for sale; good tillage and drainage; frequent seeding down to grass: in a word, diversified farming, must ere long take the place of continuous wheat cropping in Minnesota.

While permanent pastures are not best on rich tillable land in this climate, they

* Massachusetts Hatch Station, Bulletins Nos. 4 and 8; Experiment Station Record, Vol. I, p. 82, and Vol. II, p. 104.

are very useful on lands which can not be tilled in rotation, as woodlands, fields which are very rough or stony, or for other reasons difficult to plow. And, though permanent meadows are not commonly so profitable on the lands we can use in short rotations, they pay on some lands too moist to cultivate, as where broad, undrained sloughs run through fields, or where numerous swales cut up the land, making cultivation inconvenient.

Timothy is the best of the tame grasses for hay. It is hardy, may be cheaply seeded, and on ordinarily rich and moist soil, yields good crops, unless prevented by drought. It seems to grow with clover better than alone. Timothy fits into rotations well, because it makes a good crop the second year; but alone it serves for only a few years in a permanent pasture or meadow. It seems to become "sod-bound" when grown alone on droughty or even on average soils in this climate.

Redtop is our best hay and pasture grass for wet lands. * * * For hay it should be mown in early bloom. Redtop makes a poor showing in short rotations, as it requires two years for its roots to become sufficiently developed to make a strong sod. But as it continues doing well for many years, it is especially well adapted to permanent meadows on wet lands.

Kentucky blue-grass is perfectly hardy in this State, but it grows too short for meadows. It requires three years for the root stalks to become sufficiently developed to make a good stand, no matter how thickly seeded, and therefore is of no value as a pasture plant in short rotations. * * * It fits in here only in hilly woodland and other fields which must be kept in permanent pastures. [The season of growth is too short in Minnesota to allow this grass to produce abundant pasturage.]

Orchard grass is hardy, starts early in spring, and after being cut or grazed, stands drought better than timothy, and makes a good yield of hay. It is a good plant for permanent meadows on lands not too wet, since one seeding will usually last many years.

Meadow fescue, tall fescue, tall meadow oat grass, and perennial rye grass are of enough promise that we will further experiment with them, but do not advise farmers to invest in quantities of the seed of these.

Experiments with English rye grass, Rhode Island bent grass, smaller bent grass, fine top grass, crested dog's tail grass, Canada blue-grass (*Poa compressa*), sheep's fescue, and several other less widely known grasses, seem to indicate that these grasses are not adapted to any good system of agriculture in Minnesota.

Red clover has proven hardy and very valuable in the southern and central older settled parts of the State, but we trust that the northern limit within which it can be grown will be nearly the north boundary of Minnesota. For some reason red clover does not do well in newly settled sections until it has been repeatedly tried. A little should be sown every year, with the hopes that this "best preparation for crops of wheat" may eventually succeed.

Mammoth clover starts later in spring, and matures nearly two weeks later in Minnesota than the common red clover, but produces a larger first crop. It starts slower after cutting, and does not produce so large a second crop. On the whole, it produces little or no more feed in a year in Minnesota than does red clover. The mammoth variety is best to sow in all places for a green manure crop, as it grows larger than the common meadow variety. It, like common red clover, does not seem to be more than a biennial in this northern climate.

Alsike clover (*Trifolium hybridum*) is not so valuable for Minnesota as red and mammoth clovers. It produces a smaller first crop, and the second crop is usually short and light. It furnishes excellent bee pasturage. Alsike clover, like the red and mammoth species, seems to live but little longer than a biennial in Central Minnesota. It is the best clover for meadow lands, too moist for cultivated crops. If allowed to go to seed it will remain in such land several years. Hay and pasturage of Alsike clover are fine, and of especially good feeding quality.

White clover is too short for a meadow plant, and it often displaces better plants

when once it gets into meadows. It furnishes a small amount of pasturage, of excellent quality. Like Kentucky blue-grass, it produces but little feed except during several weeks in the spring, and again several weeks in the fall, unless on lands kept moist.

Alfalfa (*Medicago sativa*) is as yet in the experimental stage in this State. It will pay, if at all, only in permanent meadows, as the cost of seed and the trouble of getting a stand are so great as to preclude its use in short rotations.

PRESERVING VEGETABLES IN CARBONIC ACID GAS, S. B. GREEN, B. S. (p. 125).—A brief report of an experiment undertaken in view of the claim that seeds, vegetables, fruits, and meats might be kept from decaying for an indefinite period if they were surrounded with carbonic acid gas.

December 23, apples, potatoes, onions, chopped cabbage, and liver were put into separate two-quart glass jars. The jars were then filled with dry carbonic acid gas and sealed. Duplicate lots of each kind were put into sealed glass jars, without any carbonic acid. All of these jars were allowed to set in a heated office (temperature about 70°) until February 1, when they were opened. All the jars receiving carbonic acid gas were still full of it. The results were as follows:

The potatoes sprouted and grew more vigorously in carbonic acid than those sealed up without any carbonic acid gas.

The apples rotted fastest in carbonic acid.

The onions confined in carbonic acid threw out a few roots, and became covered with a white mold. A few of them sprouted.

The cabbage became covered with white mold and then rotted down.

The liver rotted in carbonic acid gas in a very short time.

The conclusions are obvious, and show the impracticability of such a method of preservation.

AMERICAN-GROWN CAULIFLOWER SEED, S. B. GREEN, B. S. (p. 126).—"Almost all the cauliflower seed used in this country is grown in Europe, where, from climatic and other conditions, it has been raised to better advantage than here. Attempts have been made to grow this seed in the United States from time to time, but generally without much success."

In 1889 seed of two varieties of cauliflower, Early Snowball and Erfurt's Earliest Dwarf, produced in the State of Washington, was sown at the station side by side with imported seed of the same varieties. The results were sufficiently favorable to the American-grown seed to warrant further trial of it by gardeners.

PROTECTION FROM FROST, PROF. H. A. HAZEN (pp. 127-132).—As stated in the bulletin, this is a paper furnished by Professor Hazen, of the U. S. Signal Service, at the request of D. N. Harper, Ph. D., chemist of the station. The author has devoted much time to the study of this subject, and has here summed up the results of investigations in this line.

Millions of dollars are lost to farmers and gardeners each year from frost. Any suggestion looking to a lessening of such losses must be of value, and while we have little information on which to base the best plan of action, yet it is hoped that many of those interested will take the matter up in earnest and thus accumulate facts which will make it possible to perfect a system of protection. Careful distinction should be made between frost and freezing weather. The latter comes with a cold wave

and can not be guarded against, but the former comes from a cooling produced by intense radiation of heat in a clear sky and can be largely protected against. This radiation continues all night, and, as is well known, the coldest moment is just at sunrise, or oftentimes only an hour or two before sunrise, but in that time incalculable mischief may be done. * * * In anticipation of frost the dew-point is the most essential element to be determined. When the air temperature is lowered below the dew-point we are taught that incipient condensation takes place, heat is liberated, and hence the lowest temperature during the night may be taken nearly as the dew-point of the previous evening. If we watch the dew-point of the air from 6 to 9 or 10 p. m. and find it steady and above 35° there will be little danger of frost, but if the dew-point is below 32° (freezing) frost may be looked for. [For determining the dew-point, the psychrometer is used. This instrument is described and the method of taking observations with it is explained].

Mississippi Station, Bulletin No. 12, June 25, 1890 (pp. 4).

COTTON-LEAF WORM.—Practical directions for the application of dry Paris green for the repression of the cotton-leaf worm (*Aletia argillacea*).

Nebraska Station, Bulletin No. 15, September 25, 1890 (pp. 41).

METEOROLOGICAL REPORT FOR 1889, DE W. B. BRACE, PH. D. (pp. 1–14).—This includes the records of daily observations at the university of temperature, relative humidity, rain-fall, and direction, velocity, and total daily movement of wind. Monthly and yearly summaries are also given. The yearly summary is as follows: "Barometer, highest, 31.11; lowest, 29.25; mean, 30.083. Temperature, highest, 94°; lowest, −17°; mean, 51.25°. Mean relative humidity, 72.7; range of barometer, 1.86; range of temperature, 1.11°; greatest daily range of barometer, 1.41; greatest daily range of temperature, 45°; total precipitation in inches, 21.83; number of days on which 0.01 or more of rain fell, 63; number of clear days, 153; number of fair days, 135; number of cloudy days, 77; prevailing directions of wind, north and south; maximum velocity of wind, miles per hour, 65; total movement of wind, miles, 120,255."

SOIL TEMPERATURES, 1889, J. G. SMITH, B. S. (pp. 15–35).—A detailed tabular record of observations with soil thermometers from March to November, inclusive, taken daily at 7 a. m., 12 m., and 6 p. m., at depths of 1, 3, 6, 9, 12, 24, and 36 inches.

FARM NOTES, J. G. SMITH, B. S. (pp. 37–41).

Spring wheat and rye.—Brief notes for the season of growth on 4 varieties of spring wheat and 1 of spring rye sown at the station on small plats April 8, 1890. "All gave promise of a good yield, but were cut off by hot winds and dry weather at the time the grain was filling."

Peas, lettuce, and radishes.—Tabulated notes on 14 varieties of peas. Clipper was the earliest maturing variety, but the largest yield was given by Profusion. There are also brief descriptive notes on 16 varieties of radishes and 10 varieties of lettuce.

Nevada Station, Bulletin No. 10, July 31, 1890 (pp. 4).

THE PEAR AND CHERRY SLUG, F. H. HILLMAN, B. S.—A popular account of the pear and cherry slug (*Selandria cerâsi*, Peck), with suggestions as to remedies, prepared in view of the fact that this insect is at present doing serious injury to fruit-trees in Western Nevada.

Nevada Station, Bulletin No. 11, September 5, 1890 (pp. 7).

PLANT-LICE INFESTING THE APPLE, F. H. HILLMAN, B. S. (illustrated). —Popular accounts of *Aphis mali*, *A. malifoliæ*, and *Schizoneura lanigera* and their natural enemies, with suggestions as to remedies. The bulletin is illustrated with eleven figures, some of which are from original drawings.

New Jersey Stations, Bulletin No. 68, April 30, 1890 (pp. 15).

EXPERIMENTS WITH DIFFERENT BREEDS OF DAIRY COWS, M. E. GATES, PH D.—This is a continuation of the experiment previously reported in Bulletins Nos. 57, 61, and 65 of this station (See Experiment Station Record, Vol. I, pp. 258 and 260, and Vol. II, p. 162). This bulletin includes tabulated statements under two heads, viz., "(1) monthly records of the food eaten and the yield of milk for February, March, and April, 1890; (2) the analysis of milk, which includes total solids and fat for February, and the complete analysis for March and April."

New Jersey Stations, Bulletin No. 69, July 15, 1890 (pp. 15).

ANALYSES AND VALUATIONS OF COMPLETE FERTILIZERS, E. B. VOORHEES, M. A.—Tabular statement of analyses of eighty complete fertilizers, with calculated valuations and selling prices, and schedule of trade values of fertilizer ingredients for 1890.

Of the eighty samples examined and published in this bulletin over 50 per cent contain more of each of the plant food elements than the manufacturers claim; two samples are below in all respects; the remainder show evidence of imperfect mixing, though the commercial value of the plant food furnished in many of these brands is greater than would have been secured if the guarantees had been fully reached in all respects.

New Jersey Stations, Bulletin No. 70, July 26, 1890 (pp. 15).

SOME FUNGOUS DISEASES OF THE SPINACH, B. D. HALSTED, D. SC. (illustrated).—Spinach grown under glass in New Jersey was seriously affected with fungi during the exceptionally warm and wet winter of 1889–90. In this bulletin are reported the results of an investigation in which four species of parasitic fungi were met with on spinach, namely, spinach mildew (*Peronospora effusa*, Rabenh.), spinach anthrac-

nose (*Colletotrichum spinaceæ*, Ell. and Hals.), leaf blight (*Phyllosticta chenopodii*, Sacc.), and spinach white smut (*Entyloma ellisii*, Hals.), besides several species of black molds, the most common one being *Cladosporium macrocarpum*. The descriptions of the fungi given in the bulletin are illustrated with twenty-one figures. The anthracnose and white smut appear to be newly discovered species, the former being very destructive.

This anthracnose produces blotches on the leaves, at first small and inconspicuous. The first indication of its presence is an indescribable moist appearance of the usually circular affected part, followed by the appearance of minute brown pustules, while at the same time a gray color develops and the diseased area becomes dry. * * * No particular part of the leaf is first attacked, and therefore no two leaves appear alike. In some cases the largest leaves will be diseased; in other plants only the younger ones, but sooner or later plants that are affected will become entirely unfit for use. To test the rapidity of the growth of the anthracnose, healthy plants, grown in the laboratory, were inoculated with the spores, and in from five to seven days the spots sown had become thoroughly diseased, and were bearing multitudes of spores. * * * The fine threads of the anthracnose fungus after ramifying through the leaf tissue, come to the surface at the breathing pores and pass out, forming the tufts of slender, colorless threads. Here and there, in the hemispherical radiating patches, are stiff, sharp pointed, projecting, spine-like hairs, which are invariably present, but the particular use of which is not known to the writer.

The white smut has colorless spores which give the infested leaf a light appearance, as if covered with a fine frost.

The attacked leaves were uniformly without the normal green color, and of course, worthless for market. The threads of the fungus are exceedingly small, like spider filaments, and are seen with much difficulty. There are two kinds of spores; those formed within the leaf are spherical, and grouped in small clusters just beneath a breathing pore, while the second kind are long, needle-shaped, and borne upon the ends of minute threads which pass out of each breathing pore in great numbers and form a minute tuft. * * * The spinach, because the whole plant is prepared for the table, is not well adapted to the application of remedies. A most important preventive measure is to burn all affected plants or parts, and not let the refuse of the bed go to the manure heap. If possible, change the location, soil, etc., of the beds, growing other crops in the old place for a few years. The soil to be used for spinach could be treated to a mixture of flowers of sulphur and air-slaked lime. With proper care salts of copper could be employed upon the young plants.

New York State Station, Bulletin No. 19 (New Series), June, 1890 (pp. 15).

A METHOD FOR THE DETERMINATION OF FAT IN MILK AND CREAM, P. COLLIER, PH. D. (illustrated).—This contains a plea for the adoption of a fairer basis in the buying and selling of milk, similar in import to the article on this subject by Professor Patrick in Iowa Station Bulletin No. 9 (See Experiment Station Record, Vol. II, p. 101); a description of the Parsons method for milk analysis; tables taken largely from the New Hampshire Station Report for 1889, giving the percentages of fat corresponding to the readings of the scale; and a report of the trial of the Parsons method. Some difficulty was experienced in securing satisfactory results with the method as originally published,

and after a series of trials this station advises the using of 15 cubic centimeters of the soda solution instead of 10, and 10 cubic centimeters of alcoholic soap solution instead of 5 as originally recommended. With the revised method four persons, "unskilled in chemical work," secured results, in several instances on the first trial, which differed on an average by only 0.03 per cent of fat from the gravimetric determinations. The bulletin also contains an article taken from Bulletin No. 16 of the Vermont Station (See Experiment Station Record, Vol. I, p. 320) on systems of paying for milk at creameries in Vermont, including a table for calculating the actual value of the milk as based on its fat content.

New York State Station, Bulletin No. 20 (New Series), June, 1890 (pp. 31).

PEDIGREES OF DAIRY ANIMALS UNDER INVESTIGATION, P. COLLIER, PH. D.—In view of the fact that certain strains of the several breeds have had their respective claims urged as persistently and warmly as those of different breeds, the station publishes the pedigrees of the twenty-seven animals under trial, "that such results as we shall secure in our investigation may be understood as clearly as possible."

New York State Station, Bulletin No. 21 (New Series), July, 1890 (pp. 46).

TESTING OF DAIRY BREEDS, P. COLLIER, PH. D.—A continuation of the record, which is to be published every six months, of the trial of dairy breeds commenced in April, 1889. That for the six months ending October, 1889, was given in Bulletin No. 18 of this station (See Experiment Station Record, Vol. I, page 269). The present bulletin covers the six months, from October, 1889, to April, 1890. Tables give analyses of the feeding stuffs, "mixed hays," oat hay, pea hay, barley hay, maize and alfalfa forage, maize silage, roots, ground oats, wheat middlings, wheat bran, and linseed, corn, and cotton-seed meals; and for each animal the weight and amounts of nutrients in each feeding stuff consumed per day, per month, and the total for six months; average of the animal's weights for the last five mornings of each month; and the age in days up to April 1. For each breed are given the average gain in weight, pounds of dry matter consumed per pound of gain in weight, and dry matter eaten per 1,000 pounds of weight during each month of the year's trial. For all breeds taken together are stated the average per animal of gain in weight, amount of each nutrient consumed, and amount of dry matter eaten per pound of gain in weight and for each pound of live weight of animal during the first and second six months of the trial. Particulars as to the breeding of the heifers are also given.

The purpose has been simply to present the data thus far accumulated in such form that certain of the salient points may be the more clearly seen, rather than to attempt at this early period in the investigation anything in the way of conclusions. To those who may desire, the data already secured will afford much material for care-

ful study, from which lessons of practical value may be learned, but it must not be forgotten that as yet this important investigation is but fairly begun, and it may prove that conclusions hastily deduced from even the great mass of data already secured will require, as the investigation shall progress, very serious modifications.

In the next bulletin there will begin a record of the milk product of the herd and investigations of its quality for the several purposes of the dairy.

New York Cornell Station, Bulletin No. 18, July, 1890 (pp. 15).

EXPERIENCES IN SPRAYING PLANTS, L. H. BAILEY, M. S. (pp. 29-41, illustrated).

The effect of London purple and Paris green upon peach foliage.—London purple has of late been much used on peach trees as an insecticide on account of its cheapness and its fineness and lightness, which allow it to remain longer in suspension in water. But so many complaints have been made that this arsenite is injurious to the foliage and sometimes to the young shoots that experiments have been instituted with reference to the influence of the arsenites on foliage. As the result of such experiments at the Michigan Station last year,* Professor Cook considers that—

"Peach foliage is especially susceptible to injury," that London purple is more injurious to foliage than is Paris green, and that "this is doubtless owing to the soluble arsenic which is quite abundant in London purple and almost absent in Paris green." The colored liquid left after the complete settling of the London purple was destructive to peach foliage. It appeared that greater injury occurred when the spraying was performed shortly before a rain, and that "spraying soon after the foliage puts out is less harmful than when it is delayed a few days, or better a few weeks." As a general result of the trials upon the peach, it was concluded that Paris green alone should be used, and that "not stronger than 1 pound to 300 gallons of water."

In this condition the matter rests. We still need to know if the above conclusions are applicable to other regions and other years; what are the chemical histories of these arsenites; why and how it is that the poisons injure the peach; if injury is greater at certain seasons of growth; if the time of day, meteorological conditions, methods of application, and other minor conditions influence the results. It has been supposed by many that the unusual meteorological conditions of last year were largely responsible for the injuries. We performed experiments looking in these directions last year, but desired the experience of a second season to test the subject more fully. We now find that the experiences of the two seasons coincide, so far as the experiments are comparable.

In seven experiments reported in this bulletin Paris green and London purple in mixtures of 1 pound of the arsenite to from 200 to 400 gallons of water, were sprayed on peach trees at different times from May 21 to July 8. In the earliest experiment the London purple did slight injury to the foliage, but in the other cases it proved very injurious, in some instances injuring the young shoots as well as the leaves. The injury done by the Paris green was slight. In another experiment a tree was sprayed with London purple, which was imme-

*Michigan Station, Bulletin No. 53; Experiment Station Record, Vol. I, p. 227.

diately washed off with water, and in this case the injury to the foliage was slight.

When the filtered soluble portion of London purple was used the foliage was much injured, but when the filtered solution from which the arsenite had been removed was sprayed upon the tree no injury resulted, showing that it is the arsenic and not the dye which is injurious.

Leaves injured by London purple applied in the proportion of 1 pound to 256 gallons of water were found, after thorough washing, to contain arsenic in the texture of the leaf (0.0023 gram of arsenic in 58 grams of leaves). Two analyses of leaves injured by Paris green in the same lot showed no arsenic in the texture of the leaf. The poison in the latter case had acted upon the surface of the leaf. It is apparent that London purple is the more injurious because of its soluble arsenic. The arsenic in London purple is in the form of a normal arsenite of calcium, which substance comprises about 72 per cent of the whole compound, and over 50 per cent of it, or nearly 40 per cent of the London purple, is quickly soluble in water. Paris green contains no soluble arsenic.

Experiments with coarse and fine sprays for applying the arsenites indicated that the former method is likely to do more injury to the foliage.

Our trials were made at nearly all times of day and under various meteorological conditions. Full records were made of all these conditions; but as they appear to have exercised no influence whatever, they need not be discussed here. The notion that foliage may be scorched by spraying with pure water on a bright and hot day has no foundation, else our trees would have been scorched by the Paris-green water, which was sometimes applied in very hot and bright weather.

In two experiments with London purple applied to plum-trees, no injury was done, though a careless observer would have said that the plums were injured, as many of the leaves were spotted and often perforated. But these injuries were entirely fungous (in this case, apparently due to *Phyllosticta pyrina*) and were easily distinguished from poison injuries.

Conclusions.

(1) Peach trees are very susceptible to injury from arsenical sprays

(2) London purple is much more harmful to peach trees than Paris green, and it should never be used upon them in any manner.

(3) Injury is more liable to occur upon full-grown foliage and hardened shoots than upon young foliage and soft shoots.

(4) The immunity of the young growth is due to its waxy covering.

(5) Injury late in the season is more apparent than early in the season, because of the cessation of growth

(6) Injury from the use of London purple may be permanent and irreparable.

(7) The length of time which the poison has been mixed appears to exercise no influence.

(8) London purple contains much soluble arsenic (in our samples nearly 40 per cent), and this arsenic is the cause of the injury to peach foliage.

(9) A coarse spray appears to be more injurious than a fine one.

(10) A rain following the application does not appear to augment the injury.

(11) Meteorological conditions do not appear to influence results.

(12) Spraying the peach with water on a bright and hot day does not scorch the foliage.

(13) Paris green, in a fine spray, at the rate of 1 pound to 300 gallons of water did not injure the trees. Probably 1 pound to 350 gallons is always safe.

(14) We do not discourage the general use of London purple, as we use it freely upon other plants than the peach.

Trials of nozzles.—The leading requisites of a good nozzle are stated to be "ability to throw a copious, forcible, and fine spray, and some handy means of graduating or varying the same." Various kinds of nozzles in common use are referred to and two devised at the station are described and illustrated. The first of these is a bush nozzle; the other is for use in spraying large trees. The essential feature in both is an arrangement for compressing the end of a rubber tube or hose by means of a lever to which is attached a cord passing to the hand of the operator, who by tightening or releasing the cord varies the spray as he desires.

New York Cornell Station, Bulletin No. 19, August, 1890 (pp. 16).

REPORT UPON THE CONDITION OF FRUIT GROWING IN WESTERN NEW YORK, L. H. BAILEY, M. S. (pp. 45–58, illustrated).—This is a report on investigations to get light on the causes of the general failure of fruit this season in Western New York.

So far as I am aware, there have been no general investigations to show why blossoms fail to set fruit, although the subject is eminently worthy the attention of investigators. It was so late in the season when we learned of the condition of the orchards that definite study of the causes of the falling of the bloom could not be undertaken; yet something has been learned, and the subject has been opened for research. Regarding the present condition of the trees themselves, which is far from satisfactory, more definite information can be presented.

The spring was exceedingly wet and mostly cool. When the orchards were in bloom unusually heavy rains fell, and the leaves of apples, pears, and quinces began to blight. The rains were succeeded by drought, which, in some sections, became severe.

The author is by no means convinced that the occurrence of cold and heavy rains at time of blooming will prevent fertilization of flowers, the fact probably being that these meteorological conditions greatly favor the growth of injurious fungi, which destroy the fruit. Investigations by the author and Professor Dudley showed the wide prevalence of the apple scab (*Fusicladium dendriticum*), and this is held largely responsible for the failure of the apple crop. Pear trees have been much injured by the closely related species (*Fusicladium pyrinum*), and quinces by the quince-leaf blight (*Entomosporium maculatum*). The use of copper compound for these diseases is advocated and formulas for their preparation are given.

Peaches have had at least three different enemies this year, curl leaf (*Taphrina deformans*), the curculio, and the yellows. Raspberries have been injured by anthracnose and cane rust (*Glœosporium venetum* or *G. necator*), and the strawberry blight (*Sphærella fragariæ*) has been prevalent in some sections and upon some varieties. The rots and mildews of grapes have appeared in many places in Western New York.

Fruit growers are advised to consider the advisability of endeavoring to secure a State law looking toward the control of contagious plant diseases.

Ohio Station, Bulletin Vol. III, No. 5 (Second Series), June, 1890 (pp. 22).

CORN SILAGE VS. SUGAR BEETS AS FOOD FOR MILK PRODUCTION, C. E. THORNE AND J. F. HICKMAN, M. S. A. (pp. 153–174).—The object of this experiment, which is similar to one made in 1889 (See Bulletin, Vol. II, No. 3, second series, of this station; also Experiment Station Record, Vol. I, p. 141), was to study the comparative feeding values, for milk production, of sugar-beets and corn silage when fed in such quantities as to give equal amounts of dry matter. Twelve cows, registered Jerseys and grade Shorthorns, were selected from the station herd of thirty and divided into four lots of three cows each, the lots being as nearly alike as possible in total weights and milk production, and each lot containing two Shorthorns and one Jersey.

To lots A and B were given rations containing in the one case corn silage [27 pounds daily per animal] and in the other beets [60 pounds daily per animal], these rations being fed during periods of three weeks and then transposed, the beet ration being given to the lot which had had the silage ration during the preceding period and vice versa. To lot C it was designed to feed sugar-beets and to lot D corn silage throughout the experiment in the same quantities respectively as these foods were given to lots A and B [thus giving approximately 7 pounds of dry matter in each ration], but the loss of a portion of the beets during the exceptionally warm winter rendered a modification of this part of the original plan necessary, and on April 4 lot C was changed to silage, and the silage ration of lot D was increased to 48 pounds.

The silage used was made from dent field corn, planted so thickly as to produce but little grain (about 4 per cent in the silage). The beets were Lane's Improved Imperial, rather large and coarse. In addition to the beets or silage, the daily ration of each cow contained 6 pounds of bran and a weighed amount of clover hay, the part left over being weighed back each morning. In the case of the silage-fed cows 14 pounds of hay proved more than sufficient, except in one instance. As several of the beet-fed animals were not satisfied with this amount, their hay was increased from time to time, the object being to feed in such quantities that a little hay would be found left over each day. Throughout the experiment the bran was eaten clean by every cow. The same was true of the beets and also of the silage, so long as it did not exceed 27 pounds, except that one cow refused part of both. After a preparatory period, the actual feeding experiment commenced February 19 and continued until April 25. Tables give the average live weight for each week, the average daily consumption of dry matter, yield of milk, and total gain or loss of live weight per period; and two diagrams show the fluctuations in live weight and in milk flow for each cow.

It appears that the six cows included in the two alternating lots A and B consumed on an average about 2 pounds more of dry matter per animal daily while feeding on beets than on silage; that they each gave about 20 ounces more milk per day, and gained a pound per day in weight, whereas they lost a pound on silage. * * * [Although the cows received as large a quantity of dry matter in the beet ration as

in the silage] in every instance a considerably larger quantity of hay was consumed during the beet-feeding than during the silage-feeding periods. * * * The natural downward tendency of the milk flow was in almost every case accelerated by a rapidly falling live weight, and retarded or even reversed, when the live weight became stationary or rising, and even the temporary flunctuations in live weight were, in many cases, accompanied by similar fluctuations in milk flow. Evidently the causes which operate to increase the milk flow must have a similar effect upon the live weight, and it is certainly legitimate to give a value to this increase in live weight in calculating the milk-producing value of a fodder; for under good management such increase will ultimately be utilized, either in prolonging the milk flow or in fitting the animal for the butcher's block.

Reference is made to trials in 1879 and 1889 in which beets have been compared in alternate periods with other feeds. They indicate "that in all these tests the beets have caused an increased consumption of dry matter, and that the feeding of beets has in each case been followed by an increased flow of milk."

"In respect to the production of flesh, the results of the experiments of 1889 and 1890 are at variance, as in the former the silage seemed to have a greater tendency to increase the live weight than the beets." This difference is explained, partially at least, by the fact that the corn used for silage in the experiment in 1889 was more mature and contained a larger proportion of grain than that used in 1890.

Digestibility of beets and silage.—Recent investigations at the Pennsylvania and Wisconsin Stations are cited, which indicate that from 62 to 63 per cent of the dry matter of corn silage is digestible; while "other experiments have indicated that the dry matter of beets and other similar roots is [nearly] all digestible." Notwithstanding this fact, the cows ate more dry matter while feeding on beets; "hence we must conclude that the beets exercised a more favorable influence upon the general digestion and appetite of the cows than the silage."

Relative cost of dry matter in beets and silage.—The yield of corn used for silage in 1889 on 36 acres of land averaged 16.25 tons per acre. It is believed, in view of observations made on a silo filled with clover in 1889, that the total loss or shrinkage in keeping was about 16 per cent. This would give 13.6 tons of silage containing 7,072 pounds of dry matter per acre. With the same cost 60 bushels of shelled corn per acre could have been raised, worth in the field $12, or with fodder $15. The actual cost of cutting, hauling more than one half mile, and storing the corn in the silo was $1.47 per ton; with the shorter distance and ordinary farm wages this cost might be reduced to $1 per ton, or $16.25 per acre, making the total cost of the crop in the silo $31.25 per acre. The cost of producing and harvesting 1 acre of beets, taking rental of land into account, is estimated at $37.75, and the yield, based on the average yield of the farm for eleven years past, at 16 tons per acre. Thus the cured silage in the silo would cost $2.30, and the beets in the cellar $2.36 per ton. It is thought, however, that the beets might be produced at $2 per ton in the cellar.

The silage gave, in round numbers, 7,100 pounds of dry matter per acre, 4,400 pounds of which are estimated to be digestible, and the beets, 3,750 pounds per acre, all of which is assumed to be digestible. This would make the cost of a pound of digestible dry matter in the beets 1.01 cents and in the silage 0.71 cent.

Profit and loss.—The following estimate of the relative cost of the feed for the alternating lots A and B during nine weeks in the experiment of 1890, and for the alternating lots C and D during eight weeks in the experiment of 1889, is based on clover hay at $9, bran at $13, silage at $2.30, and beets at $2 per ton:

	Total cost of feed during experiment	Total yield of milk during experiment.
Lots A and B (1890):		*Pounds*
With beets	$29.86	2,733
With silage	22.25	2,374
Difference	7.61	359
Lots C and D (1889):		
With beets	25.59	2,357
With silage	20.39	2,309
Difference	5.20	48

No account is taken of the silage refused, which amounted to about 10 per cent of the total amount fed, because the refuse was of no further value as feed. In the case of the hay, however, it was the aim in both experiments to offer more than would be eaten; hence only that actually eaten is calculated. * * * [In the experiment of 1890] the increase of live weight apparently due to the beets, added to the increase of milk, would amply justify the increased cost of feed; but in last year's experiment [1889], the increase of live weight was greatest with the silage; hence we are in doubt whether the difference this year may not be due to an inferior quality of silage [it being made from less mature corn and containing a smaller proportion of grain than the corn used in 1889].

The authors conclude that before beets and silage can safely be compared on the basis of their digestible dry matter it must first be conclusively demonstrated that the increase in live weight in 1890 apparently due to beets was in reality due to this cause and was not merely accidental.

Corn silage vs. dry-cured fodder corn.—Abstracts of observations on this subject made at the New Jersey, Massachusetts, Wisconsin, Iowa, Maine, Michigan, New York, Missouri, and Illinois Stations.

Ohio Station, Bulletin Vol. III, No. 6 (Second Series), July, 1890 (pp. 36).

EXPERIMENTS IN WHEAT SEEDING, J. F. HICKMAN, M. S. A. (pp. 175–183).—This article is not confined to the discussion of new work, but is, in the main, a report of progress, adding another to the series of tests begun twelve years ago (in 1878). The report for 1889 may be found in Bulletin Vol. II, No. 5, second series, of the station (See Experiment

Station Record, Vol. I, p. 287). As before, the topics are (1) thick and thin seeding; (2) early and late seeding; (3) seeding at different depths and by different methods. With two exceptions Velvet Chaff (Penquite's) wheat was used in all of the experiments reported.

Thick and thin seeding.—This experiment has been repeated during nine seasons. In previous years the land used for the experiments has been "second bottom and light clay loam, with gravel subsoil," but this year "first bottom or low land was used." An attempt was made to duplicate the experiments with Velvet Chaff wheat by using a variety named Dietz on other plats, but these were injured by freezing and excessive moisture. In other years the rates of seeding have been from 2 to 9 pecks per acre; this year a 10 peck rate was added. In 1890 the results varied but little. The 5-peck rate gave a slightly higher yield than any of the others, but this was closely followed by the 7, 4, and 6-peck rates. For the nine years the 7-peck rate gives the highest average yield, but is closely followed by the 5 and 6-peck rates.

Early and late seeding.—A table gives the dates of seeding from August 22 to November 1, yield per acre of grain and straw, and pounds of straw per 100 pounds of grain for eleven plats used in 1890. The best results this year were obtained from seeding between October 4 and November 1. In another table the yields of grain per acre in similar experiments during seven seasons are compared.

After seven years' trial we have found that, with a single slight exception, the highest yields have been produced from seeding during the last week in September and the first week in October.

For 1890 the product from the land seeded November 1 was almost as high as where the seeding was a month earlier. This was probably due to the unusually open winter of 1889–90.

Methods of culture and different depths of seeding.—The results attained by various methods of seeding, Lois Weedon culture, mulching, and different depths (½ to 4 inches) of planting the seeds are given in one table for 1890 and in another for five seasons. The variety of wheat used in 1890 was Martin's Amber. Better yields have been obtained from seeding from 1½ to 2 inches deep than from shallower or deeper planting. "Five years' experiments with the roller or wheel following in the track of each drill hoe indicate that the practice may be a good one; at least it is worthy of a more thorough test."

COMPARATIVE TESTS OF VARIETIES OF WHEAT, J. F. HICKMAN, M. S. A. (pp. 184–205).—For an account of similar experiments in 1889 see Bulletin Vol. II, No. 5, second series, of the station, and Experiment Station Record, Vol. I, p. 289.

All the tests of varieties of wheat at this station from 1882 to 1889 were conducted on the "south field." For the trial of 1890 a level field of alluvial bottom-land, with quite uniform soil, which had been in clover three years, was thoroughly prepared by plowing, rolling, and harrowing, and was divided into tenth-acre plats. A diagram of the plats

is given in the bulletin. Sixty-one varieties were sown, 56 on this field and 5 on other land. The results obtained this year are given in tabular form for 55 varieties. Another table contains a compilation of results of tests of 60 varieties for ten years, showing the yield of each variety for each year it has been grown at the station, and also the average yield for the period it has been grown here. A third table gives the yearly and average yield of 15 of the most reliable varieties grown at the station for six years. The following are especially commended: "The Valley, Nigger, Penquite's Velvet Chaff, and Diehl Mediterranean among the red bearded wheats; of the smooth, red wheats, the Red Fultz, Poole, and Finley; of white wheats, Silver Chaff (smooth), Royal Australian (Clawson), Martin's Amber, and Democrat."

In another table are contained the results obtained in 1890 with fifteen varieties of wheat planted on the river bottom on clover sod and after corn, beets, and oats in rotation, and on second bottom-land which had been in wheat nine years.

The results, as shown by the table, do not indicate that the land on which the rotation was followed has been materially impoverished by the successive cropping; but in the south field, where continuous cultivation has been followed, the effect is much more marked.

Not only the total product of straw, but the number of pounds of straw to each hundred pounds of grain is much less on the high ground than on the bottom-land.

The grain from the second bottom was in each case equally as good and in most varieties perceptibly better in quality than that from the lower ground.

Synonyms.—[The following statements are by the director of the station.] Sibley's New Golden and Tasmanian Red appear to be the old Mediterranean under new names. Reliable, Valley, and Egyptian closely resemble each other in the field, but show slight differences in the grain. We have not been able to distinguish Red Fultz and German Emperor from Michigan Amber. Poole resembles these closely, but is distinct. Witter was classed with them last year, but is distinct and inferior. The only point of distinction we have yet found between Hungarian and Geneva is the excessive smuttiness of the former. Diehl Mediterranean, Golden Cross, Missouri Blue Stem, and Seneca Chief are one and the same variety. Royal Australian is the old Clawson under a new and high sounding name. Finley and Fultz are not distinguishable, whether in the field or granary. Silver Chaff, Martin's Amber, and Landreth resemble each other so closely that we can not yet describe their points of difference, if they have any. Martin's Amber may prove to be slightly different after further comparison. Of other varieties we are yet in doubt. It is not always possible to decide positively whether two differently named lots of wheat are identical or otherwise from a single season's observations, especially if the seed has been obtained from different localities.

Large vs. small plats.—The results on the tenth-acre plats in 1890 are compared with those on plats of from ½ to 1.3 acres for four varieties. In only one case is there any material difference in the rate of yield per acre on the large and small plats, and that was probably due to the lodging of the wheat.

Bearded vs. smooth and red vs. white wheats.—A table gives the average yields of bearded and smooth and of white and red varieties for each of ten years and for this whole period.

The record includes ninety-five trials of white wheats and three hundred and thirteen of red wheats. The average yield per acre for the white wheats has been 30.8 bushels per acre, while the greater number of red wheats have averaged 31.5 bushels per acre for this series of ten years. During the ten years one hundred and sixty-two trials of bearded wheats have been made, giving an average of 31.7 bushels per acre, while two hundred and thirty-four trials of smooth wheats have given an average of 31.1 bushels.

The differences in the yields of these different classes of wheat in so many trials covering so long a period, are so slight as to indicate that under the conditions prevailing at this station one kind is about as reliable as another.

Test of varieties on black soil.—This is a report by the director of the station of the first of a series of tests to be conducted on a farm 39 miles west of Columbus "in a section of country where there are large areas of black land, either covered originally with burr-oak and elm or bare prairie." This is a matter of considerable interest to many Ohio farmers, for such soil, unless it contains a considerable admixture of sand, is generally found to be less suited to the production of wheat than soils whose lighter color indicates a smaller proportion of organic matter in their composition.

The special field used for the experiment had been in rotative cultivation for many years, the crop for 1889 being corn. Twelve varieties of wheat were selected from those which had given the best results at the station. They were sown in plats of one tenth acre each, about the middle of September, the remainder of the field (30 acres) being sown with Egyptian wheat.

About the middle of June rust made its appearance in this field, and by June 20 the entire field was covered. An examination made on that date revealed no marked difference in the amount of rust on the different varieties.

The results on three plats sown with Velvet Chaff (Penpuite's) indicated that the soil was sufficiently uniform to make the test satisfactory. This variety produced a larger yield than any of the others on all three plats, thus justifying its recommendation for such soils, which has been given in previous years by the university and station.

Variety tests by farmers.—Under this head are given reports on tests of 12 varieties of wheat, by farmers who bought seed of the station and planted it on different kinds of soil. The reports are also summed up in a table.

SMUT IN WHEAT, J. F. HICKMAN, M. S. A. (pp. 205–208).—"Reports from various sections of the State indicate more injury to the wheat crop of 1890 from what is known as stinking smut than for any previous year of which we have any definite information." A table gives the per cent of smut as estimated in the field, and the number of smutted grains in each one thousand after recleaning. Four varieties, New Monarch, Farquhar, Hungarian, and Ontario Wonder, were very much more affected than the others. The estimated percentage of wheat which was winter-killed is also given for fifty varieties, ranging from 3 to 60 per cent.

RESULTS OF EXPERIMENTS WITH FERTILIZERS ON WHEAT, C. E. THORNE (p. 208).—In a brief note appended to the bulletin are stated the general results of this year's experiments with fertilizers on the station farm. The details will be published in a future bulletin in connection with the results of similar experiments on corn and oats. "On this farm, where by thorough drainage and tillage we have been able this year to produce an average of 30 bushels of wheat per acre without any fertilizer, no combination of commercial fertilizers has produced sufficient increase of crop to pay the cost of the fertilizer, although barn-yard manure has paid more than three times the cost of its application."

Ohio Station, Bulletin Vol. I, No. 2 (Technical Series), May, 1890 (pp. 100).

A CATALOGUE OF THE UNCULTIVATED FLOWERING PLANTS GROWING ON THE OHIO STATE UNIVERSITY GROUNDS, M. CRAIG, B. S. (pp. 49–110, illustrated).—This was prepared as a thesis for the degree of Bachelor of Science at the university, and as the author states in a foot-note, might properly have been entitled "a catalogue of uncultivated phenogams, with notes on their abundance, distribution, and time of blooming."

The catalogue includes four hundred and sixty-eight species and varieties of the one thousand six hundred and forty-six which have been found in this State. The article is illustrated with a map of the university grounds.

FOURTH CONTRIBUTION TO A KNOWLEDGE OF THE LIFE HISTORY OF CERTAIN LITTLE-KNOWN PLANT LICE,* C. M. WEED, M. S. (pp. 111–120).—Notes on the cherry plant-louse (*Myzus cerasi*, Linn.), willow grove plant-louse (*Melanoxanthus salicti*, Harris), spotted willow plant-louse (*Melanoxanthus salicis*, Linn.), white pine plant-louse (*Lachnus strobi*, Fitch), toothed willow plant-louse (*Lachnus dentatus*, Le Baron), the Scotch pine plant-louse (*Lachnus pini*, L.). The notes are accompanied by five plates containing photo-reproductions made from living or freshly-killed specimens by Miss Freda Detmers under supervision of the author.

A DESCRIPTIVE CATALOGUE OF THE SHELLS OF FRANKLIN COUNTY, OHIO, H. A. SURFACE (pp. 121–148).—Descriptive notes on forty-nine species of mollusca, illustrated with two plates containing forty-two photo-engravings. "Most of these illustrations are reproduced from the papers of W. G. Binney, but some are from drawings by Miss Freda Detmers."

* For the preceding contributions of this series see Psyche, Vol. V, pp. 123–134, 208–210; Ohio Station, Bulletin Vol. II, No. 6, second series, pp. 148–152, and Experiment Station Record, Vol. I, p. 291.

Tennessee Station, Bulletin Vol. III, No. 3, July, 1890 (pp. 24).

POINTS ABOUT COUNTRY ROADS, W. W. CARSON, C. E., M. E., (pp. 43–64).—In an introduction the director of the station states that this article was prepared at his request by Professor Carson, who occupies the chair of civil engineering in the University of Tennessee, with a view to aiding the movement in that State in favor of better country roads.

As the farmer gets the same price for what he sells whatever distance he has to haul his produce to the railroad station the cost of hauling comes entirely out of his pocket. It has been estimated that our poor roads cost the farmer at least $15 a year for every horse. The question of improved road making is thus of great importance.

"For a country road, the question of most importance is the draft; that is, the number of horses needed to draw a given load, or (to state it otherwise) the load that one horse can draw. We need, therefore, to see what effect different grades and road coverings have on draft." Tables are quoted from General Gilmore's work entitled "Roads, Streets, and Pavements," to show the relative draft of different kinds of roads at different grades. Calculations based on these tables are given to show how the work done by the horse is distributed and what are the effects of different grades and kinds of roads on the cost of hauling. The author favors the payment of the road tax in money instead of labor and the employment of State and county engineers to superintend the making of roads. The location and construction of proper roads are discussed in some detail.

Utah Station, Bulletin No. 1, June, 1890 (pp. 12).

INVESTIGATIONS IN PROGRESS AT THE STATION, J. W. SANBORN, B. S. (illustrated).—Brief historical statements are made relating to the experiment station enterprise in this and other countries. The Utah Station was founded by an act of the Territorial legislature of 1888, but was not organized until near the end of 1889, when a director was appointed. Five buildings for the use of the station are being erected, a laboratory, bank barn (surrounded by a silo, root cellar, hog-house, engine-house, and wagon-shed), farm and dairy-house, and two cottages. The station is also well equipped with chemical apparatus and farm and horticultural implements. The legislature of the Territory has supplemented the national grants of money by a liberal appropriation for buildings, farm tools, and stock. "Eighty-five acres of the station farm are now covered with crops; 40 acres are serving the combined purposes of inquiry and economic farming." The field experiments now in progress include tests of grasses, clovers, and other forage plants; oats, wheat, corn, barley, sorghum, and sugar-beets; the cultivation of corn, potatoes, and wheat; rotation of crops; tests of fertilizers; and the

relative ability of different crops to obtain nitrogen from the air. Box experiments are also being made with reference to soils, vaporization of water, and the growth of various crops. Feeding experiments, meteorological observations, and tests with the dynamometer are also planned. In horticulture, tests of varieties of apples, pears, plums, peaches, cherries, strawberries, raspberries, apricots, and various other fruits, and of vegetables and economic fruit-trees not grown in the Territory, have been commenced. Systems of tillage and irrigation will also be tested by the horticultural department. Plans and descriptions of the farm and dairy-house, barn, and the front elevation of the laboratory and farm-house are given.

Virginia Station, Bulletin No. 7, July, 1890 (pp. 16).

VARIETY TESTS WITH STRAWBERRIES, W. B. ALWOOD (illustrated).—In the introduction the importance of fruit and especially of strawberry culture in Virginia, is urged. "The varieties under test at the station were planted in April, 1889, on a fairly strong clay-loam soil, which had but recently been broken up from sod. The land has a gentle slope to the south, and except that it is somewhat inclined to wash, is a fairly good situation. * * * The plants were set in rows 4 feet apart, and 2 feet apart in the row, and were given clean culture, care being taken to remove all blossoms which appeared the first year, as it was desired to get a strong stand of plants for this year's test. The runners were trained so as to give matted rows. The length of row was quite uniformly 30 feet." The vines were mulched during the winter with favorable results.

The best yield at the station was from 5,000 to 8,000 quarts per acre. This, it is true, is an estimated yield, made from 30 feet of row, and no one pretends that it could be easily duplicated on an acre; yet, as an indication of what can be attained, it certainly has value. One to two thousand quarts per acre ought to be grown in practical culture.

Tabular data are given for forty-nine varieties, including the dates of first blooming and first and last picking, number of days in bearing seed, quality and value for market and home use (on a scale of 10), yield for four different periods of picking, from June 2 to June 24, and total yields, and productiveness (on a scale of 10). There are also descriptive notes on the varieties tested and illustrations of five of the promising new varieties. A list of one hundred and three varieties now being tested at the station is given.

The following new varieties are recommended as worthy of trial in this State for commercial purposes: Bubach No. 5, Crawford, Eureka, Haverland, Miami, and Parry. Bubach No. 5, Haverland, and Sharpless are especially recommended for home use. Belmont, Bomba, Crawford, First Season, Jessie, and Parry are also considered worthy of trial for this purpose.

It is thought that mulch, even in the warm climate of this State, can be profitably used. The facts in this regard should be learned by careful tests.

It is advisable to plant but few varieties, and select them with care, having in view vigor and productiveness of plant, size, character, and quality of fruit. Pistillate varieties should be interspersed with perfect flowering sorts, usually three to five rows of the former to one of the latter.

Wisconsin Station, Bulletin No. 24, July, 1890 (pp. 18).

A NEW METHOD FOR THE ESTIMATION OF FAT IN MILK, ESPECIALLY ADAPTED TO CREAMERIES AND CHEESE FACTORIES, S. M. BABCOCK, PH. D.—The object of this, as of several methods lately described (Short, Parsons, Patrick, Failyer and Willard, Cochran, and others), was to devise a simple and quick method for the determination of the percentage of fat in milk, fitted for the use of breeders and dairymen for estimating the value of cows as milkers, in order to improve their stock, and by creameries in adjusting the price to be paid to patrons.

As in several of the other methods named, acid is added to the milk and the albuminoids, casein, fibrin, etc., are changed to soluble acid-albumins, which offer less resistance to the rising and aggregation of the fat globules. The peculiar feature of this method consists in placing the bottles containing the acidified milk in a centrifugal machine, by the rapid revolution of which the fat is made to separate more quickly and completely.

The bulletin describes the apparatus, chemicals, and manipulation of the method in sufficient detail to be understood by those who have not the training of the laboratory.

Approximately equal volumes of milk and commercial sulphuric acid of 1.82 specific gravity are mixed in a test bottle with a long graduated neck. A pipette delivering about 17.5 cubic centimeters of milk, and a measuring cylinder for the acid are used. The bottles are "whirled for several minutes at a temperature of about 93° C. (200° Fah.), in a horizontal wheel making from seven to eight hundred revolutions per minute. This wheel is surrounded by a copper jacket, which may be filled with hot water for heating during the test. "The separation of fat by gravity alone is not complete even when the bottles are left standing for several hours; with the centrifuge, however, a perfect separation is accomplished in a few minutes" If whirled at once no heat need be applied, as that caused by the strong acid and milk is sufficient. After whirling, the bottles are filled to the neck with hot water, returned to the machine, and whirled for one or two minutes longer, after which they are filled with hot water "to about the 7 per cent mark," and the machine is again turned for a short time, the temperature being kept up by means of a kerosene lamp or filling the jacket with hot water. The fat separates out and is read off while still liquid, preferably at about 65° C. (150° Fah.), the reading giving the per cent of fat directly without calculation and being easily taken to 0.1 per cent.

With skim-milk, buttermilk, or whey, in which there is but little fat, it is recommended to treat four portions in as many bottles and collect all the fat in one bottle, or better, to use a bottle holding three or four times as much as the ordinary test bottle. With sour buttermilk or milk that has stood a considerable time before testing, the tendency of the albuminoids to precipitate on the addition of water may be avoided by using a hot mixture of equal parts of sulphuric acid and water instead of water alone.

In testing cream the test sample may be divided about equally into two or three parts and treated in as many bottles, the several readings being added. The sources of error and means of avoiding them are described, and the results of forty comparative tests with the gravimetric (asbestos) and the above-described method are given.

In thirty samples of whole milk the new test gave results in fifteen cases higher and in fifteen cases lower than the gravimetric determinations, the average being 0.107 per cent higher than the gravimetric, and the greatest difference 0.3 per cent. In two samples of skim-milk the results with the new test averaged 0.035 per cent higher, in three samples of buttermilk 0.17 per cent lower, in one sample of whey 0.07 per cent higher, and in four samples of cream 0.02 per cent lower than the gravimetric determinations. "Several tests have been made with both condensed milk and with cheese, which have given a clear separation of fat." In three such tests the new method gave results averaging 0.12 per cent lower than those of the gravimetric method, and in one sample of condensed milk 0.18 per cent higher.

"Two samples of milk may be tested in duplicate in fifteen minutes, including all the work, from the mixing of samples to the cleaning of the bottles. After the milk has been measured sixty tests may be made in less than two hours, including the cleaning of the bottles. * * * The cost of the test will depend upon the price of commercial sulphuric acid. One pound of acid is sufficient for fourteen tests. In a factory where acid is purchased by the carboy it should not cost more than one fifth cent per test, and in no case should it cost more than one half cent per test. The breakage of bottles, if properly made, is so slight that it need not be considered."

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

DIVISION OF ORNITHOLOGY AND MAMMALOGY.

NORTH AMERICAN FAUNA No. 4 (pp. 55).

DESCRIPTIONS OF TWENTY-SIX NEW SPECIES OF NORTH AMERICAN MAMMALS, C. HART MERRIAM (illustrated).—This number includes descriptions of seven species of the little striped skunks (genus *Spilogale*), with suggestions regarding revision of the genus; five ground-squirrels of the genus *Tamias*; an *Evotomys* from Colorado; two species of *Evotomys* from the Pacific coast region; a marten (*Mustela caurina*) from the Northwest coast; a species of *Molossus* from California; a prairie-dog from Wyoming; three ground-squirrels of the *Spermophilus spilosoma* group; three kangaroo rats, with remarks on the identity of *Dipodomys ordii* of Woodhouse; a pocket gopher of the genus *Geomys*, from Western Nebraska; and a species of *Hesperomys* from Southern Florida. The illustrations consist of three plates with eleven figures, and three figures in the text.

DIVISION OF ENTOMOLOGY.

INSECT LIFE, VOL. III, No. 2, SEPTEMBER, 1890 (pp. 41–87, illustrated).—The principal articles in this number are on the clover mite (*Bryobia pratensis*, Garman), by C. V. Riley and C. L. Marlatt; an outbreak of the army-worm, and some other insects affecting grain in Maryland, by W. H. Ashmead; some of the bred parasitic *Hymenoptera* in the national collection (continued), and descriptions of certain lepidopterous larvæ, by H. G. Dyar. There is also a report of the proceedings of the Entomological Club of the American Association for the Advancement of Science, at Indianapolis, August, 1890, by F. M. Webster, secretary.

DIVISION OF POMOLOGY.

BULLETIN No. 3 (pp. 14).

CLASSIFICATION AND GENERIC SYNOPSIS OF THE WILD GRAPES OF NORTH AMERICA, T. V. MUNSON.—"This is intended as preliminary to a complete monograph on the wild grapes of this country, now in course of preparation by this Division."

DIVISION OF BOTANY.

BULLETIN—No. 12.

GRASSES OF THE SOUTHWEST, PART I, G. VASEY (illustrated). "This bulletin is to constitute the first half of the first volume of a work entitled Illustrations of North American Grasses. The work when completed will consist of two volumes, the first entitled, 'Grasses of the Southwest, the second, Grasses of the Pacific Slope. Proper title-pages and indexes will be published with the last part of each volume." In this number are included plates and descriptions of 50 species of the grasses of the desert region of Western Texas, New Mexico, Arizona, and Southern California, as follows: *Ægopogon geminiflorus*, *Andropogon cirrhatus*, *A. hirtiflorus*, *A. saccharoides*, *A. wrightii*, *Aristida arizonica*, *A. divaricata*, *Bouteloua arenosa*, *B. aristidoides*, *B. Burkei*, *B. eriopoda*, *B. havardii*, *B. hirsuta*, *B. humboldtiana*, *B. oligostachya*, *B. prostrata*, *B. racemosa*, *B. ramosa*, *B. stricta*, *B. trifida*, *Buchloë dactyloides*, *Cathestecum erectum*, *Cenchrus myosuroides*, *C. tribuloides* *Chloris alba*, *C. ciliata*, *C. cucullata*, *C. glauca*, *C. verticillata*, *Elionurus barbiculmis*, *Epicampes macroura*, *E. rigens*, *Eremochloë bigelovii*, *E. kingii*, *Eriochloa sericea*, *Heteropogon contortus*, *Hilaria cenchroides*, *H. mutica*, *Melica diffusa*, *M. porteri*, *Muhlenbergia distichophylla*, *M. gracilis*, *Panicum bulbosum*, *P. ciliatissimum*, *P. lachnanthum*, *Setaria caudata*, *Stenotaphrum americanum*, *Stipa flexuosa*, *Thurberia arkansana*, *Trachypogon polymorphus*, *Tragus racemosus*.

Probably the most important agricultural question before the people of this region is how to increase the production of grasses and forage plants on the arid lands. It is the opinion of many that this can be done by bringing under cultivation some of the native species. Experiments are about to be undertaken in this direction by the agricultural experiment stations and by individuals. The first step in such an enterprise is a knowledge of or an acquaintance with the native species. Nothing can be better adapted to this object than the work here undertaken, and in this way the knowledge of the scientist can be made helpful to the practical economist. * * * A second part of an equal number of plates is now in preparation, after which it is proposed to publish an analytical synopsis of all the grasses of the desert region. The drawings of the grasses have been made chiefly by Mr. William R. Scholl, and in the description of the species I wish to acknowledge important aid from Mr. Frederick V. Coville, assistant botanist.

CENTRAL EXPERIMENTAL FARM OF CANADA.

Bulletin No. 7, April, 1890 (pp. 13).

TWO ROWED BARLEY, WILLIAM SAUNDERS.—Replies from a number of maltsters, brewers, and corn brokers in Great Britain, based on samples of two-rowed barley grown in Canada in 1889, are quoted to show that such barley is likely to be favorably received in the English market. The varieties included in the samples were Carter's Prize Prolific, Danish Chevalier, Danish Printice Chevalier, Beardless, and English Malting. The valuations given in the replies above referred to ranged from 78 cents to $1.12 and averaged 94 cents per Canadian bushel of 48 pounds, delivered in England.

Taking the average cost of transportation from Canada to England to be 15 cents per bushel and allowing 3 cents additional for commissions and incidental expenses, this would leave the farmer, on the basis of the lowest of the estimates given, 60 cents here for the Canadian bushel; taking the average figure, it would be 76 cents, and on the higher estimates 88 to 94 cents.

Placing the exports of Canadian barley at 10,000,000 bushels, every cent per bushel added to the price obtained for it puts $100,000 into the pockets of the farmers, and had the entire crop of surplus barley of 1889 in Canada been two-rowed and sold at the lowest figures which have been given for the poorest of the samples sent to England, instead of shipping the crop to the United States at an average of about 45 cents, the gain to the farmers of Canada would have amounted to $1,500,000, and could the average price which has been named have been obtained, the difference would have been over $3,000,000. With such possibilities in view the wisdom of making a strong effort in that direction can scarcely be questioned by any reasonable mind.

It is also stated that experiments at the experimental farms in Canada, as far as they go, indicate that with proper cultivation two-rowed barley will improve rather than deteriorate in the climate and soil of Canada.

EXPERIMENT STATION NOTES.

The Post-Office Department has recently ruled that "in sending out bulletins from an agricultural experiment station it is permissible to inclose postal-cards to enable correspondents of the station to acknowledge the receipt of its publications and to request their continuous transmission."

ARKANSAS STATION.—G. L. Teller, B. S., formerly of the Michigan Station, has been appointed chemist of this station, vice C. B. Collingwood, B. S., who has gone to the Arizona Station. Special features of the present work are feeding experiments with cotton-seed products, and investigations on Texas fever and insecticides.

CONNECTICUT STATE STATION.—Cotton-seed meal containing only 35.19 per cent of albuminoids (the average should be at least 42½ per cent), and adulterated with rice meal or refuse, has recently been found on sale in this State.

CONNECTICUT STORRS STATION.—C. B. Lane has been appointed assistant in farm experiments, vice E. A. Bailey. Hon. J. W. Alsop, M. D., of Middletown, has recently given the station $500 to enable it to prosecute on a more liberal scale its investigations on the acquisition of the free nitrogen of the air by plants. A greenhouse is being erected for use in these researches. The feeding experiments with milch cows begun in the spring of 1890 will be continued, a special subject of study during the coming winter being the variations in the quality and quantity of milk without and with change of ration.

KANSAS STATION.—The bulletins of this station for the ensuing year are designed to be complete records of the experiments reported in them, and will not be reprinted in the annual report of the station. They will be paged consecutively and a complete index of their contents will be published at the close of the year.

N. S. Mayo, D. V. S., formerly assistant in veterinary science at the Michigan Station, has been appointed instructor in physiology and veterinary science at the Kansas Agricultural College, and will have charge of experiments in animal physiology and veterinary science.

LOUISIANA STATIONS.—William C. Stubbs, jr., has been appointed farm manager at the Sugar Experiment Station, vice A. M. Gardner, B. S.

MARYLAND COLLEGE AND STATION.—T. L. Brunk, B. S., late of the Texas College and Station, has been appointed horticulturist of this station and professor of botany and horticulture of the college. The station has made exhibits at five county fairs in Maryland this season. The experiments with tomatoes recorded in the annual report for 1889, have been duplicated and somewhat extended this year.

MASSACHUSETTS STATE STATION.—The principal lines of investigation during the past season have been (1) field experiments on the effect of different forms of nitrogen on oats, and of different forms of phosphoric acid on potatoes, and comparative tests of different grasses and grass mixtures; (2) feeding experiments with reference to the fattening qualities of different breeds of pigs, and the comparative merits of old and new-process linseed meals as feeding stuffs for milch cows. Among the experiments now in progress are those relating to the economical production of beef and mutton, the effects of gluten and cotten-seed meals as feeding stuffs for milch

cows, and hot-house experiments with different forms of nitrogen on grains to supplement field experiments in this line. An orchard of large fruits has been set out, in which the effects of different fertilizers on fruits will be tested.

MICHIGAN STATION.—In co-operation with the State Live Stock Sanitary Commission the station has begun experiments to learn whether actinomycosis in cattle is contagious. Spurry has been introduced on the "Jack-pine plains" as a fertilizing and forage crop with good promise of success. H. C. Spencer has retired from the State Board of Agriculture.

NEW YORK CORNELL STATION.—M. I. Slingerland has been appointed assistant entomologist, vice J. M. Stedman, B. S. The first of several small buildings for the use of the veterinary division is now being erected for use in experiments relating to the causes and prevention of contagious diseases among domestic animals. It is to be built of hollow vitrified brick with cement floors, and will be so arranged that the different stalls can be easily and securely isolated. Extensive alterations in the university barn have been begun to secure increased facilities for feeding experiments, especially with pigs.

OREGON STATION.—An exhibit of one hundred varieties of grain and four hundred and twenty-five varieties of potatoes was made by the station at the State Fair and at the Northwest Exposition at Portland, Oregon.

RHODE ISLAND SCHOOL AND STATION.—The erection of a veterinary hospital has been begun on plans furnished by F. E. Rice, M. D., M. R. C. V. S., the recently appointed veterinarian of the school and station. The building is to be of wood, 76 by 46 feet, and three stories high. It will contain offices, drug and apparatus room, lecture room, large stable with eight box stalls and an operating floor.

The governing board of this station is at present organized as follows: Melville Bull, B. A., treasurer, C. H. Coggeshall, C. O. Flagg, B. S., president and director, J. H. Eldredge, M. D., and C. J. Greene, secretary. The station made exhibits at the State and Washington County Fairs of varieties of grains, grasses, clovers, potatoes, and other vegetables, and of work in apiculture.

SOUTH CAROLINA STATION.—The station was transferred November 1 to Pendleton, S. C., where it will be connected with the Clemson Agricultural College, of which H. A. Strode is president. The station staff is at present organized as follows: H. A. Strode, director; J. F. Duggar, assistant director; and M. B. Hardin, chemist.

SOUTH DAKOTA STATION.—In the station staff as now organized, L. McLouth Ph. D., is president *ex officio;* L. Foster, M. S. A., director and agriculturist; and W. S. Frost, accountant and stenographer, vice C. J. Coote, B. S. J. C. Duffy, B. S., is no longer a member of the staff.

The results of the sugar-beet culture at this station this season are quite satisfactory. A sugar yield of 17.85 per cent of the whole beet has been obtained from varieties grown from seeds imported and distributed by this Department. This result is 5.55 per cent greater than any other yet obtained by this station from beets grown from American seeds. The importance of perfect maturity has been made a special feature of the experiment this season. The results of different analyses made at intervals of four days each, beginning when the beets were apparently mature showed a remarkable increase of saccharine matter. Three successive intervals showed each an increase of 1 per cent, and sixteen days, from October 9 to 25, a gain of 34 per cent.

TEXAS STATION.—Among the investigations now in progress at this station are digestion experiments with different feeding stuffs and feeding experiments with pigs on a relatively large scale, in which the effects of cotton seed and cotton-seed meal will be tested.

VIRGINIA STATION.—Dr. Charles Ellis has been appointed veterinarian of the station. A forcing-house is to be erected for the use of the horticultural department.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

OCTOBER 1 TO NOVEMBER 1, 1890.

DIVISION OF ENTOMOLOGY:

Periodical Bulletin, Vol. III, No. 2, September, 1890.—Insect Life.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, Vol. II, No. 3, October, 1890.

DIVISION OF ORNITHOLOGY AND MAMMALOGY:

North American Fauna No. 4.—Descriptions of Twenty-six New Species of North American Mammals.

DIVISION OF STATISTICS:

Report No. 77 (new series), September, 1890.—Report on Condition of Crops in America and Europe, and Freight Rates of Transportation Companies.

Report No. 78 (new series), October, 1890.—Report on Condition of Crops, Yield of Grain per Acre, and Freight Rates of Transportation Companies.

DIVISION OF POMOLOGY:

Bulletin No. 3.—Classification and Generic Synopsis of the Wild Grapes of North America.

DIVISION OF VEGETABLE PATHOLOGY:

Bulletin Vol. VI, No. 2, September 10, 1890.—Journal of Mycology.

DIVISION OF BOTANY:

Bulletin No 12, Part 1, October 13, 1890.—Grasses of the Southwest.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

OCTOBER 1 TO NOVEMBER 1, 1890.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Bulletin No. 18 (new series), August, 1890.—Climatology of Alabama.

ALABAMA CANEBRAKE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 9.—Crops for Silage; Forage Plants and Grasses.

ARKANSAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 13, August, 1890.—Strawberries.

Bulletin No. 14, September, 1890.—The Effects of the Arsenites upon Plants.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF CALIFORNIA:

Bulletin No. 88, October 6, 1890.—The use of Fertilizers in California.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 104, October, 1890.—Fertilizers.

Iowa Agricultural Experiment Station:

Bulletin No. 10, August, 1890.—Our Rusted and Blighted Wheat, Oats, and Barley in 1890; Experiments with Arsenites; Stocks for the Cherry, Plum, Prune, and Apricot; A Chemical Study of Blue-Grass; Corn Fodder.

Kansas Agricultural Experiment Station:

Bulletin No. 12, August, 1890.—Preliminary Experiments with Fungicides for Stinking Smut of Wheat.

Bulletin No. 13, August, 1890.—Experiments with Oats.

Kentucky Agricultural Experiment Station:

Bulletin No. 30, August, 1890.—Wheat Experiments; A New Wheat Insect.

Louisiana State Experiment Station:

Bulletin No. 3 (second series).—Report of Horticultural Department.

Bulletin No. 4 (second series).—Irish Potatoes.

Maine State College Agricultural Experiment Station:

Annual Report, Part III, 1889.

Maryland Agricultural Experiment Station:

Special Bulletin, October, 1890.—Composition of Commercial Fertilizers Sold in this State.

Massachusetts State Agricultural Experiment Station:

Bulletin No. 38, September, 1890.—Feeding Experiments with Milch Cows.

Hatch Experiment Station of the Massachusetts Agricultural College:

Bulletin No. 10, October, 1890.—Report on Special Fertilizers for Greenhouse Crops; Report on Small Fruits.

Meteorological Bulletin No. 22, September, 1890.

New Jersey State and College Agricultural Experiment Stations:

Bulletin No. 72, October 4, 1890.—Plant-Lice, and How to Deal with Them.

Bulletin No. 73, October 6, 1890.—Analyses and Valuations of Complete Fertilizers.

Cornell University Agricultural Experiment Station:

Bulletin No. 20, September, 1890.—Cream Raising by Dilution; Variations in Fat of Milk Served to Customers in Dipping from the Cans.

Ohio Agricultural Experiment Station:

Bulletin Vol. III, No. 6 (second series), July, 1890.—Experiments in Wheat Seeding; Comparative Tests of Varieties of Wheat; Wheat Smut.

Texas Agricultural Experiment Station:

Bulletin No. 12, September, 1890.—The Screw Worm.

Agricultural Experiment Station of Utah:

Bulletin No. 1, June, 1890.—Investigations in Progress at the Station.

West Virginia Agricultural Experiment Station:

Bulletin No. 7.—Experiments upon Wheat, Fruit-Trees, Garden Seeds, Grasses, Forage Crops, and Miscellaneous Subjects.

Agricultural Experiment Station of the University of Wisconsin:

Bulletin No. 25, October, 1890.—Feeding Bone Meal and Hard-Wood Ashes to Hogs Living on Corn.

DOMINION OF CANADA.

Department of Agriculture:

Central Experimental Farm, Bulletin No. 7, April, 1890.—Two-Rowed Barley.

Guelph Agricultural College:

Bulletin No. 54, October 1, 1890.—Corn Silage and Roots as Food Factors in Swine Feeding.

EXPERIMENT STATION RECORD.

Vol. 2. JANUARY, 1891. No. 6.

EDITORIAL NOTES.

The Association of American Agricultural Colleges and Experiment Stations held its fourth annual convention November 11-13 at Champaign, Illinois, with the University of Illinois. The association is made up of representatives of the land grant colleges and experiment stations and of the United States Department of Agriculture.

The meeting was the largest the association has yet held. There were one hundred and ten delegates, representing thirty-nine States and Territories, and about seventy colleges and stations. It was noticeable and the cause of frequent congratulation that this convention contained an unusually large number of the experiment station workers, in addition to the directors. President Smart of the Purdue University of Indiana, presided at the general sessions. As a full report of the proceedings will be published as a separate bulletin of the Office of Experiment Stations, only general references to the action of the convention need be made here.

An amendment to the constitution adopted at the Washington convention in 1889 provided for the division of the association into sections, or permanent committees, as they were originally called. Sections have been organized in agriculture, botany, chemistry, college work, entomology, and horticulture. Their meetings were held during the recesses of the general association, and consumed the greater part of the time allotted to the convention. They were taken up with discussions of a technical character. A list of the topics presented in each section is given below.

At the first general meeting of the association the chairmen of the sections elected at the last meeting were called upon for reports of progress made in their several lines of work at the stations and elsewhere during the past year. The papers presented justified the expectation of the last convention that these reports would furnish a most important feature of the association meetings. Especially full and valuable were the reports upon chemistry and entomology.

At the first public meeting, held on the evening of November 11, after short addresses by Regent Peabody of the University of Illinois, by a representative of the city of Champaign, and by several members of the convention, President Smart's annual address was read. He laid stress upon the value and importance of technical and mechanical education, and asserted its right to a place of honor by the side of the old classical and disciplinary college course.

In accordance with regulations requiring that at each annual convention certain sections should present in the general session of the association papers upon topics of especial importance, papers were read from the horticultural section on The Work of Experiment Stations in the reform of Vegetable Nomenclature, by L. H. Bailey of New York; and on Methods of Work in Variety Testing, by W. J. Green of Ohio. Both papers were well received and furnished the subjects of interesting discussions.

Mr. A. W. Harris, assistant director of the Office of Experiment Stations, read a paper outlining a plan for a co-operative exhibit by this Office and the experiment stations to be made in connection with the exhibit of the United States Department of Agriculture at the Columbian Exposition. A committee of five appointed to consider the matter reported the following resolutions, which were adopted:

Resolved, That in the opinion of this association it is advisable to have a co-operative station exhibit at the World's Columbian Exposition.

Resolved, That to formulate and carry out such preliminary steps as are necessary during the year, a special committee, with power to represent the association, be appointed by this convention to co-operate with the Department of Agriculture and to take such other action as may be necessary.

Resolved, That the executive committee be authorized to pay from the funds of the association the actual and necessary expenses incurred by the above-named committee in the discharge of its duties.

In pursuance of these resolutions the following committee was appointed: H. P. Armsby, Pennsylvania, chairman; George E. Morrow, Illinois; C. E. Thorne, Ohio; S. M. Tracy, Mississippi; W. A. Henry, Wisconsin.

The director of the Office of Experiment Stations addressed the association on the work of the Office. With other subjects, he presented a plan for a co-operative index of station publications and other literature. At the close of the convention an informal meeting of station directors and others interested was held for the consideration of this and other matters. The need of an index of station literature was very clearly brought out, and the Office was urged to begin its preparation as soon as practicable.

The following officers were elected for the ensuing year: President, H. H. Goodell of Massachusetts; vice-presidents, O. Clute of Michigan, A. Q. Holladay of North Carolina, E. D. Porter of Missouri, I. P. Roberts of New York, and J. W. Sanborn of Utah; secretary and treasurer, M. A. Scovell of Kentucky; executive committee, H. E. Alvord

of Maryland, M. C. Fernald of Maine, H. H. Goodell of Massachusetts, W. M. Hays of Minnesota, J. A. Myers of West Virginia, M. A. Scovell of Kentucky, J. H. Smart of Indiana.

On the evening of the 13th, after the close of the convention, the delegates and visitors present were tendered a reception by Regent Peabody at his residence. After the convention some fifty members visited the Fat Stock Show in Chicago, at the invitation of the Illinois State Board of Agriculture.

At the meeting of the section on botany the following papers were presented: Reference Books, How to Obtain and Use them, by J. C. Arthur, D. Sc., of the Indiana Station and Purdue University; Anthracnose of Cotton and Black Rot of Cotton, by G. F. Atkinson, Ph. B., of the Alabama College and Station; Potato Scab, by R. Thaxter, Ph. D., of the Connecticut State Station; New Fungous Diseases, by L. H. Pammel, B. Agr., of the Iowa College and Station; Fungicides, by D. G. Fairchild of the United States Department of Agriculture; Copper Salts for the Black Rot, by W. B. Alwood of the Virginia Station; Co-operation in Bulletins, by W. J. Beal, Ph. D., of the Michigan College and Station; Weed Killing in the Prairie States, by C. A. Keffer of the South Dakota College and Station; Seed Testing and its Value, by G. McCarthy, B. S., of the North Carolina Station; Grasses for Arid Regions, by Dr. George Vasey of the United States Department of Agriculture; The Station Bulletin, by B. D. Halsted, D. Sc., of the New Jersey College and College Station.

In the section on chemistry the following papers were presented: Recent Work Abroad on the Digestibility of Feeding Stuffs, by H. P. Armsby, Ph. D., of the Pennsylvania Station; Results of some Investigations of the Metabolic Products in Dung and of the Action of Pepsin Solution on Dung, by W. Frear, Ph. D., of the Pennsylvania College and Station; Observations made at the Wisconsin Station on the Size and Number of Fat Globules in Cows' Milk, by F. W. Woll, M. S., of the Wisconsin College and Station; Newly Proposed Apparatus and Methods, by E. H. Jenkins, Ph. D., of the Connecticut State Station; The Determination of Phosphoric Acid in Phosphates containing Oxide of Iron and Alumina, by S. W. Johnson, M. A., of the Connecticut State Station and Sheffield Scientific School, and T. B. Osborne, Ph. D., of the Connecticut State Station.

At a joint session of the sections on chemistry and agriculture butter standards, methods of testing milk, and co-operative field experiments were discussed.

In the section on horticulture the following topics were presented: Methods of Note taking in Variety Tests, and Experiments in Crossing Corn, by G. W. McCluer, B. S., of the Illinois Station; Promising Wild Fruits of North Dakota, by E. B. Waldron of the North Dakota Station; Methods of Reporting the Yield of Small Fruits and Other Crops, by E. S. Goff of the Wisconsin College and Station.

In the section on entomology the following papers were presented: Certain Notes and Observations of the Season at the Iowa Experiment Station, by C. P. Gillette, M. S., of the Iowa Station; The Life History of *Baris confinis*, and Life History of certain *Aphididæ*, by C. M. Weed, D. Sc., of the Ohio Station; A New Root-Rot Disease of Cotton, by G. F. Atkinson, Ph. B., of the Alabama College and Station; New Notes on the Life History of the Hessian Fly, by J. Marten of Illinois; The Laboratory Method of Experimentation, by C. W. Woodworth, M. S., of the Arkansas Station; Practical Notes on the Use of Insecticides, by M. H. Beckwith of the Delaware College and Station; The Host Relations of Parasitic *Hymenoptera*, by L. O. Howard of the United States Department of Agriculture; Experiments for the Destruction of Chinch-Bugs in the Field by the Artificial Introduction of Contagious Diseases, by F. H. Snow of Kansas.

In the section on college work, President J. H. Smart of Purdue University, made an address on Waste in College Work. A large share of the session of this section was devoted to a discussion of the duties and obligations of the colleges growing out of the recent act of Congress in their behalf. As the result of this discussion the following resolutions were adopted:

1. That every college should keep a separate and distinct account with the income to be derived under the act of Congress approved August 30, 1890.

2. That in the expenditure of the new college income the institutions here represented should conform to a strict interpretation of the language of the law as to the application of these funds.

3. That in view of the history of the new Morrill act and the decisions of the first comptroller of the Treasury that under it the two annual payments are now due and payable to the States, and the fact that instruction during the academic year of 1889–90 is a thing of the past, the annual payment of $15,000 for the year ending June 30, 1890, should be regarded as far as practicable as an equipment fund, and that the annual payment now past due for the year ending June 30, 1891, should be applied to the expenses of the current academic year.

4. That the officers of this association be requested to respectfully urge upon the Secretary of the Interior the early payment to every State and Territory having one or more institutions organized under the act of July 2, 1862, of both payments now due under the supplementary act of 1890, in accordance with the evident intention of Congress to apply these benefits equally to all the States and Territories, and in order to avoid impeding the progress and development of industrial education, which would result from withholding payments and reporting the same to Congress.

5. That the first reports to the Secretary of the Interior by college presidents and treasurers should be made in the year 1891 before the first day of September and should cover the operations of the year ending June 30, 1891, and the disbursements of the income for that year, together with the use made of the first payment of $15,000.

6. That this association desires to acknowledge its appreciation of the courtesy and liberal spirit shown by the Secretary of the Interior in his action regarding the new Morrill act, and is gratified by the assignment of the business arising under this act to the Bureau of Education, with which the institutions concerned have official relations already existing, and it is respectfully suggested that the future transactions between the Department of the Interior and the colleges may be simplified and all interests conserved by making the Bureau of Education the depository of all the records and reports and the medium for direct intercourse with the colleges on all matters requiring final action by the Secretary of the Interior.

7. That the college officers should endeavor to bring to the attention of the legislatures of the respective States, at the earliest possible date, the necessary legislative action under the provisions of the new Morrill act, and the representatives of the colleges present at this convention pledge their action and influence to insure an equitable division or impartial application of all moneys received under this act in full accord with the spirit of the law.

In the section on agriculture the following topics were presented: Pot *vs.* Field Plat Experiments, by C. E. Thorne of the Ohio Station; Is a Digestion Experiment Fallacious? by H. P. Armsby, Ph. D., of the Pennsylvania Station; Specific Compounds Bearing on Feeding Experiments, by H. H. Wing, B. Agr., of the New York Cornell Station; The Relations of Tillage to Soil Physics, by J. W. Sanborn, B. S., of the Utah College and Station; Station Records, by G. E. Morrow, M. A., of the Illinois College and Station; Testing Varieties, by J. F. Hickman, M. S. A., of the Ohio Station; What the Lysimeter Teaches, by F. H. King of the Wisconsin University and Station; Equalizing the Irregularities of Plats caused by Defective Germination, by T. F. Hunt, B. S., of the Illinois Station.

The Association of Economic Entomologists held its meeting during the same days as the convention of the general association, its sessions alternating with those of the section on entomology.

At the meeting of the Association of Economic Entomologists the annual address was delivered by the president, Prof. C. V. Riley of the United States Department of Agriculture, the subject being the Outlook in Applied Entomology. The following topics were presented in papers or addresses: Work of the Entomologists in the Experiment Stations, by A. J. Cook, M. S., of the Michigan College and Station; Fertilizers as Insecticides, Notes on the Plum Curculio, an Experience with the Rose Bug, Questions Relating to *Aphididæ*, Invasion by the Clover-leaf Beetle, and Experiments with Acetic Acid as a Preservative, by J. B. Smith, of the New Jersey College Station; The Habits of *Pachyneuron*, by L. O. Howard, of the United States Department of Agriculture; Notes on the Plum Curculio and Plum Gouger, by C. P. Gillette, M. S., of the Iowa Station; Notes on Beet-Root Insects, by L. Bruner, of the Nebraska Station; A Summary History of the Corn Plant Louse, and The Life History of White Grubs, with Description of New Stages, by S. A. Forbes, Ph. D., of the Illinois University; The Life History of Wire-Worms by C. A. Hart of Illinois; Notes of the Year in Canada, by James Fletcher of Canada. There were also discussions on the habits of *Agrotis fennica*, dry *vs.* wet applications of insecticides, traps for cut-worms, the pupating habits of canker-worms, and methods of preventing injury by borers.

ABSTRACTS OF BULLETINS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

Alabama College Station, Bulletin No. 19 (New Series), October, 1890 (pp. 16)

ROADS AND ROAD MAKING, J. H. LANE, C. E. (pp. 3–13).—This article, by the professor of civil engineering and drawing in the Agricultural and Mechanical College of Alabama, was prepared at the request of the board of directors of the station, and, as the author is careful to state, was largely compiled from standard works on this subject.

REPORT OF ALABAMA WEATHER SERVICE, P. H. MELL, PH. D. (pp. 14–16).—Brief notes on the weather during September, and a monthly summary of meteorological data and of observations of soil temperatures.

Alabama Canebrake Station, Bulletin No. 9 (pp. 17).

CROPS FOR SILAGE, FORAGE PLANTS, AND GRASSES, W. H. NEWMAN, M. S.

Crops for silage (pp. 3–7).—Early Amber, Early Orange, and Large African sorghum, Kaffir corn, Pearl millet, Yellow millo maize, and teosinte were planted April 8, 1889, on twentieth-acre plats, on "black slough" bottom-land. The sorghums and Yellow millo maize gave the largest yield and teosinte the smallest. "Kaffir corn made a short, stocky growth, and was not eaten readily by cattle." Pearl millet made a good growth, but was inferior to sorghum as a silage crop. Stock preferred Early Orange and Early Amber sorghum. The yields of green fodder per acre for each of two cuttings are given for each variety in a table. Early Orange yielded 29,960 pounds per acre July 19, and 8,300 pounds September 9. Chicken corn sown on one fourth acre yielded at the rate of 22,520 pounds of green fodder per acre at the first cutting and 3,760 pounds of cured hay at the second cutting. Pea vines are stated to be "almost the best crop we can grow" for late silage, but are difficult to handle, and would probably pay better if cured for hay under proper conditions. Seven tons of common field corn fit for silage were produced on one half acre of "shell ridge" land. The station silo, an ordinary wooden structure located above ground, is described and direc-

tions for constructing and filling a silo are given. The following statements are taken from the summary given in the bulletin:

From two years' experience with the silo we believe it can be successfully used by the farmers of the State.

Corn when planted in the drill from 12 to 18 inches apart and 3 to 4 feet in the row is the best crop for silage.

The large varieties of saccharine and non-saccharine sorghums rank next to corn as a silage crop, the saccharine being better than the non-saccharine.

Forage plants and grasses (pp. 8–17).—Notes are given on alfalfa (*Medicago sativa*), Bokhara clover (*Melilotus alba*), red clover (*Trifolium pratense*), German millet, herd's grass, Kentucky blue-grass, tall meadow oat grass, timothy, orchard grass (*Dactylis glomerata*), Texas blue-grass (*Poa arachnifera*), cow-peas, barley and rye for winter soiling, and sorghum for summer soiling. *Alfalfa* was sown October 18, 1888, on one fifth acre of unfertilized "black slough" bottom-land. The first cutting, May 7, 1889, gave 1,140 pounds of cured hay per acre; the second, August 10, 1889, 2,300 pounds; the third, January 18, 1890, 1,800 pounds of green fodder; the fourth, May 7, 1890, 1,200 pounds; and the fifth, June 17, 1890, 1,220 pounds. *Bokhara clover* is recommended as the best and cheapest crop for restoring the fertility of the waste canebrake land. *Red clover.*—Plats sown in 1884 continue to yield two to four cuttings of excellent hay each season. "Clover is one of the best hay plants that can be grown on either the red or the black prairie lands." *German millet.*—"For a quick crop of hay nothing is better," but it is a very exhaustive crop and requires fertilizing. *Herd's grass, Kentucky blue-grass, tall meadow oat grass, and timothy*, on rich "black slough" bottom failed to produce pasturage or hay, owing to the heat and dryness of the summer in that section. *Orchard grass* was a failure as a hay crop, but "for pasturage we think it will prove a success." *Texas blue-grass*, in the experience of the author, requires to be propagated by sets—a costly method and "not practicable, except on a small scale." *Cow-peas*, grown extensively at the station, are deemed the best annual crop for hay and as a fertilizer on prairie soil. "The increased yield by leaving the vines will not pay for the hay that can be cut, and when cut the land is much easier prepared. On the black and red prairie lands the different varieties of cow-peas grow to perfection, and the effect of one crop of vines on corn and cotton is very remarkable. Growing a good crop of vines on the black or red prairie lands is the cheapest and quickest way of improving them." *Barley and rye for winter soiling.*—Barley sown in the fall of 1889 gave three cuttings (aggregating 23,100 pounds per acre), and rye gave four. "Unless the land is very rich it is better to sow rye." Southern seed should be used. *Sorghum for summer soiling.*—"From three to six cuttings can be obtained in one season, and 1 acre will yield from 30,000 to 40,000 pounds. Early Amber and Early Orange gave the best results."

California Station, Bulletin No. 88, October 6, 1890 (pp. 4).

THE USE OF FERTILIZERS IN CALIFORNIA, E. W. HILGARD, PH. D.—From the increasing correspondence on the subject, the author concludes that soils in that State which have long been occupied or heavily cropped are beginning to require serious care to maintain or restore their productiveness.

In a great many instances the failure to produce satisfactory crops is not at all due to soil exhaustion, but to improper physical conditions of the subsoils, unsuitable cultivation or irrigation, alkali, etc. The fact that orchards and vineyards form costly investments of much greater permanence than the annual crops that occupy the vast majority of the cultivated land east of the Rocky Mountains, and the high returns so often realized from them, have brought the manure question forward here much earlier than has usually been the case in the United States. * * * In order to fertilize intelligently we must know first of all what ingredients are chiefly drawn upon by the crop sold off the land; secondly, we must know which of these ingredients are so abundantly present in the soil (or irrigation water, as the case may be) as to render their replacement unnecessary for the present at least.

Estimates of the quantities of fertilizing ingredients taken off by average crops of grapes, oranges, pears, plums, and apples, mostly based on European analyses, are given, followed by a discussion of the importance of analysis of soils and irrigation waters, and the needs of soils of different sections of California.

The great majority of soils in this State, more especially nearly all valley soils, and absolutely all soils in which there is the least manifestation of alkali, contain an abundance of available potash for all agricultural purposes; so much so that dissolved potash salts frequently circulate in the soil water. Most irrigation waters furnish an additional supply, sometimes enough of itself to make up for all that crops take away. * * * Phosphoric acid is one of the substances to be first suspected of exhaustion in the non-alkaline soils of California; it is therefore an ingredient that should be prominent in all compound commercial fertilizers and which will be found to pay in most cases of decreasing production. * * * From climatic causes humus is rarely abundant in the upland soils of the State, and very generally its amounts may be said to be small. This is especially true of the mesa soils of the South—those best adapted to the growth of the citrus fruits—and hence it is reasonable to suppose that a lack of nitrogen will be among the first things to be apprehended when that fruit shrinks in size and production fails on these soils.

The forms of nitrogenous fertilizers are described and directions given for the use of these, and of bones. "This station has no direct or definite knowledge of the quality or 'trueness to name' of any of the commercial fertilizers now sold in this State." The desirability of a fertilizer control is urged.

Connecticut State Station, Bulletin No. 104, October, 1890 (pp. 20).

FERTILIZER ANALYSES.—Tabulated analyses of 65 samples of nitrogenous superphosphates and guanos, and 33 of special manures collected by special agents of the station in all parts of the State during April and May, 1890.

Of the sixty-five brands of nitrogenous superphosphates analyzed, twenty-two, or more than one third, contain less of a single ingredient than is required by the manufacturer's guarntee. In only seven cases is there a deficiency of the most valuable ingredient, nitrogen, and in several cases the deficiency is in potash and due to a form of guarantee which is misleading and in this State illegal. The manufacturer is required to guarantee the actual potash. Potash, sulphate, 4 per cent, is understood to mean 4 per cent of actual potash in the form of sulphate, and not 2.16 per cent of potash combined with 1.84 per cent of sulphuric acid.

The average cash ton price of these sixty-five brands has been $33.74; the average valuation, $28.14; the difference, $5.60; and the percentage difference, 19.9 per cent. This means that in general the purchaser has paid about one fifth more per pound for nitrogen, phosphoric acid, and potash when purchased ready mixed than he has had to pay for the same elements of plant food unmixed.

Special manures.—Of the thirty-three brands analyzed, ten contain less of a single ingredient than is required by the manufacturer's minimum guarantee, and two others are thus deficient in two ingredients.

Eleven of the special manures are designed particularly for the potato crop. The opinions of manufacturers, as well as those of farmers, would seem to differ widely regarding the fertilizers best suited to this crop, for the per cent of nitrogen in the several potato manures ranges from 2 to 5.3 per cent, the phosphoric acid from 7.7 to 11.2, and potash from 4.2 to 10 per cent. If applied according to the manufacturer's directions, the different potato manures would supply from 13 to 53 pounds of nitrogen, from 52 to 100 pounds of phosphoric acid, and from 30 to 54 pounds of potash to the acre. Four of the formulas contain about a third of their nitrogen in the form of nitrates, but four others contain no nitrates whatever. Two others contain all but a fraction of 1 per cent of their nitrogen in the form of ammonia salts, but four others contain no ammonia. It is evident that while each of these several brands may be an excellent general fertilizer, the claim that each or a majority of them is preeminently adapted to the special needs of the potato crop would be absurd.

Illinois Station, Bulletin No. 11, August, 1890 (pp. 16).

EXPERIMENTS WITH WHEAT, T. F. HUNT, B. S. (pp. 337-352).

Effect of fertilizers on wheat.—These experiments were made to test the value of commercial fertilizers in the production of wheat on Illinois soils—to determine the relative increase where they were used, and to study the forms of plant food most needed. A report is given of seven trials made in 1888-89 and 1889-90, two trials being on the station grounds and five on farms in different localities in the State. Winter wheat was used in all cases. The fertilizers were stable manure, 20 loads; cattle tankage, 400 pounds; superphosphate, 400 pounds; muriate of potash, 100 pounds; sulphate of potash, 200 pounds; and nitrate of soda, 100 pounds per acre. These were used singly, and in the case of the potash salts, superphosphate, and nitrate, two by two and all three together. They were applied in some cases at the time of seeding, and in other cases part at the time of seeding and part (potash salts and nitrate) to the young crop in the spring. On one unfertilized plat a mulch of oat straw was used. The yields of wheat and straw and per cent of increase over unfertilized plats are shown in tables and a diagram.

The trials with commercial fertilizers in the production of wheat do not indicate that their application will be found generally profitable in Central Illinois. * * * Although the per cent of increase from the use of stable manure, cattle tankage, and superphosphate was often considerable, being as high as 92 per cent in one case and in many cases 25 per cent or more, still the total increase in yield was not sufficient to pay for the cost of the fertilizers used. * * * Fertilizers containing phosphoric acid generally produced the most effect, those containing potash the least. Good stable manure was generally equal to any other fertilizer. In one trial made during a season favorable to wheat, no benefit was obtained from mulching wheat with straw at the rate of 1¼ tons per acre.

Methods of soil preparation.—In 1888 four different methods were tested. Wheat was in one case drilled in standing corn, and in three others on fourth-acre plats from which silage corn had been removed, the land being in one instance plowed, rolled, disked, and harrowed; in another twice disked, but not plowed; and in a third case receiving no preparation. In 1889 the land on which wheat had been drilled in standing corn in 1888 was drilled to wheat after the following preparation: On two plats the stubble was burned, the land being in one instance plowed, and in the other disked six times, and on the third plat the stubble was plowed in.

"Drilling wheat in plowed ground has given better yields than drilling in corn stalks or drilling in open ground prepared with a disk harrow. Rolling the ground after drilling did not injure the wheat this season, which was a severe one." There was very little difference in the first trial between the yield where the land was disked and where it received no preparation; in the second trial the plat on which the stubble had been burned gave the best results, but the low yield on the unburned plat may have been due to the fact that the ground was somewhat lower than the rest and "the wheat killed out much worse."

Quantity of seed per acre.—Experiments were made in 1888–89 on four plats, 2 by 6 rods each, seeded at the rate of 4, 5, 6, and 8 pecks per acre, and in 1889–90 on five plats, 2 by 4 rods each, seeded at the rate of 3, 4, 5, 6, and 8 pecks per acre.

The tabulated results show the largest yield of wheat in 1888–89 to have been where 5 pecks of seed were used, while in 1889–90 with 4 pecks and 8 pecks the yields were practically alike and larger than the others, though less by 10 bushels than the largest yields in 1888–89. "It would seem that the rate of seeding affects the yield less than other items in wheat culture."

Time of sowing.—In 1888 and 1889 wheat was drilled at different dates between September 12 and October 15, 6 pecks of seed being used per acre. In the former year the plats contained 12 and in the latter 16 square rods each. "The character of the seasons materially influenced the results," as is shown by the table of yields. The largest yields were on plats which were seeded in 1888, September 29, and in 1889, September 12. "The experiments indicate that sowing wheat in October is not a safe practice in this latitude."

Effects of time and manner of harvesting on the yield of wheat.—The objects of the experiments were to ascertain (1) the stage of growth at which the largest yield of grain may be secured; and (2) whether, after cutting, any of the substances of the straw pass into the kernel, and if so, the manner of harvesting most advantageous for this.

The observations extended over two years, 1888 and 1889. Each year twelve 5-pound samples were taken each week, from the time when the kernels were small and watery till they were hard and ripe and the straw dry. The heads of four samples were removed immediately, and both straw and heads dried under shelter. Without removing the heads from the stalks four other samples were dried in imitation of shocked grain, in the same room as the preceding four, and four were spread on the ground in the sun until thoroughly air-dry. Tables give the average weights of 1,000 kernels, 100 heads, 100 culms, and of straw and chaff at different stages. The weights both of 1,000 kernels and of the kernels from 100 culms were in both years the largest when the kernels were ripe and hard, and at this stage the weights were larger where the heads were removed immediately than where they were first dried on the stalks. Among the author's conclusions are the following: "At the earlier stages of seed formation a considerable transfer of material from the straw to the kernel may occur after cutting, if the wheat is placed in conditions similar to the shocking and capping of bound sheaves. * * * The results indicate that it is better to allow the wheat to get nearly if not entirely ripe [to secure the maximum yield] and that if it be necessary to cut at a much greener stage, shocking and capping would probably be beneficial."

Louisiana Stations, Bulletin No. 1 (Second Series), (pp. 25).

ANALYSES OF COMMERCIAL FERTILIZERS AND OTHER SUBSTANCES USEFUL TO AGRICULTURE, W. C. STUBBS, PH. D.—A report on the analysis of forty-four samples of commercial fertilizers, besides cotton-seed meal, tankage, bone meal, bat manure, natural phosphate, marl, water, Paris green, and bituminous coal. Popular explanations of fertilizing ingredients and the valuation of commercial fertilizers are given, together with the full text of the State fertilizer law.

Louisiana Stations, Bulletin No. 2 (Second Series), (pp. 14).

TEXAS SCREW WORM, H. A. MORGAN, B. S. A. (pp. 29–39).—A record of observations and experiments by the author during the past summer, in view of the fact that the Texas screw worm (*Lucilia macellaria*) has been unusually prevalent in Louisiana, causing much injury to stock, and in some cases even the death of human beings. Animals were purchased by the station for this investigation, which will be continued during the winter. The life history of the insect is described and illustrated. "The larvæ we had under our control remained in

this condition from the 19th to the 24th and 25th of August." One lot continued in the pupa state from the 7th to the 14th of August, another from the 13th to the 20th of the same month. Observations and experiments indicate that the eggs of this insect deposited on decaying animal and vegetable matter will hatch and come to maturity there.

"All the natural openings of animals are liable to be attacked, particularly the sheaths of horses and mules and the navels of newly born stock, while in all animals where an abrasion of the skin is made an attack may be expected.

"Among the worst cases that have come under my observation were when the horns of animals had been broken; the maggots penetrated the head, and when the animals were not at once attended to they soon died. The majority of cases throughout the country resulted from the deposition of eggs upon the animals in the vicinity of where ticks (*Ixodes bovis*) had been killed, the flies being attracted by the blood. I have observed that when sheep become sick and emaciated the odor characteristic of sick sheep attracted the flies, and masses of eggs were deposited in the folds of the wool and the young larvæ penetrated the skin where no wound had been made."

From the fact that this insect has not been largely prevalent in this State until this summer, which followed an exceptionally warm winter, the author thinks that they are usually held in check by the cold of the winters in that section. The burial of decaying animal and vegetable substances is advocated as a means of repressing the screw worm. Experiments with chloroform, carbolic acid, corrosive sublimate, calomel, ether, turpentine, kerosene, gasoline, and some patent remedies showed that these remedies are more or less effective. Pyrethrum insect powder and decoctions made with the leaves of various plants proved ineffective. The author is inclined to prefer crude carbolic acid, which should be applied of sufficient strength to destroy the maggots. The wound should then be washed with warm water and dressed with carbolized oil.

"To prevent the attacks of the fly there is nothing simpler or more convenient than a mixture of tar and grease or fish oil smeared about the parts; so long as the smell lasts the flies do not seem to deposit their eggs."

Maryland Station, Special Bulletin, July, 1890 (pp. 48).

Potash and paying crops.—A reprint of a compilation prepared by the German Kali Works.

Maryland Station, Special Bulletin, October, 1890 (pp. 15).

COMPOSITION OF COMMERCIAL FERTILIZERS SOLD IN THIS STATE, H. E. ALVORD, C. E.—This bulletin, which is the first publication under the requirements of the new fertilizer law, contains analyses made by Prof. J. D. Hird of forty-eight brands of commercial fertilizers, popular explanations of fertilizer valuations, the text of the new fertilizer law of Maryland, and special notes for the farmers of the State regarding its enforcement.

Massachusetts State Station, Bulletin No. 38, September, 1890 (pp. 12).

FEEDING EXPERIMENTS WITH MILCH COWS, C. A. GOESSMANN, PH. D. (pp. 1–7).—The object of these experiments was to compare the effect of new and old-process linseed meal on the quantity and quality of milk produced, and on the cost of feed. Five cows, from six to seven years old, all grades, and of fair milking quality, were used. The trial extended over six successive months. During the first three months the cows were all fed on old-process linseed meal, wheat bran, corn meal or carrots, and either hay, fodder corn, or hay and corn silage. The average yield of milk for this time was 8.6 quarts daily per animal, and the average net cost of food per quart of milk 1.4 cents. During the remaining three months (six periods) old and new-process linseed meals were compared, each being fed in connection with other feeding stuffs for three periods, as indicated in the summary given below. The feeding of the coarse fodders was at all times regulated by the appetites of the animals, the unconsumed portions being weighed back each day.

Tables give the composition of old and new-process linseed meal, the fertilizing ingredients in each of the materials fed, their value based on nitrogen at 17 cents, phosphoric acid at 6 cents, and potassium oxide at 4½ cents per pound, and a short statement of the results of the experiment, the details being reserved for the annual report of the station. According to the analyses stated the dry matter of the new-process linseed meal contains 41.02 per cent of crude protein (old-process 36.97) and 2.17 per cent of fat (old-process 7.24), and has therefore about 4 per cent more crude protein and nearly 5 per cent less crude fat than the old-process meal; and the value of the fertilizing constituents in 1 ton of meal is $3.50 higher in the new-process meal, owing largely to the larger quantity of nitrogen. The estimates of the net cost of food per quart of milk are based on corn meal at $19 per ton, wheat bran at $17.50, old-process linseed meal at $27, new-process meal at $26, hay and rowen at $15 each, carrots at $7, corn silage at $2.75, and sugar-beets, fodder corn, and corn stover at $5 each per ton, account being taken of the fertilizing ingredients obtainable in the manure.

The average results for the last three months of the trial (six feeding periods) are given in the following summary:

Daily averages for six periods.

Rations fed per day	Average daily milk production.	Analysis of milk. Per cent of solids.	Per cent of fat.	Net cost of feed per quart of milk.	Milk required for one space of cream.
3¼ pounds wheat bran, 20 pounds carrots, 16 pounds stover, and—	*Quarts.*			*Cents.*	*Quarts.*
3¼ pounds old process linseed meal	8 45	13. 67	4. 32	1. 13	1. 60
3¼ pounds new-process linseed meal	9. 06	13. 17	4. 48	1. 04	1. 67
3¼ pounds corn meal, 3¼ pounds wheat bran, 20 pounds sugar-beets, 16 pounds hay, and					
3¼ pounds new-process linseed meal	10. 03	14. 05	4. 59	1. 75	1. 74
3¼ pounds old-process linseed meal	9. 78	14. 00	4 64	1. 78	1. 73
3¼ pounds corn meal, 3¼ pounds wheat bran, 20¾ pounds rowen, and—					
3¼ pounds old process linseed meal	10 41	13 61	4 56	1 35	1. 76
3¼ pounds new process linseed meal	9 88	13. 68	4. 14	1. 38	1. 81

The experiment indicates that at the prices stated above for the two feeds the effects of old and new-process linseed meals on the cost of milk, when fed in like quantities, are practically the same. "In case the new-process linseed meal is used the net cost of the milk is somewhat less on account of the larger amount of fertilizing elements it contains, which somewhat increases the value of the obtainable manure. This advantage is, however, in the majority of instances, to some extent compensated for by a somewhat more liberal yield of milk in case old-process linseed meal has been fed." The milk of the individual cows was, in general, slightly richer in fat when old-process meal was fed, but although the dry matter of the old-process meal contained nearly 5 per cent more crude fat than that of the new, the difference in the effects of the two feeds on the composition of the milk was not marked.

ANALYSES OF COMMERCIAL FERTILIZERS, C. A. GOESSMANN, PH. D. (pp. 8–12).—A report of the inspection of forty-two commercial fertilizers offered for sale in Massachusetts during the past season.

Massachusetts State Station, Circular, August, 1890 (pp. 4).

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES, C. A. GOESSMANN, PH. D.—Analyses of twenty-one commercial fertilizers, including ground bone and bone meal, made under the Massachusetts fertilizer law, and of wood and cotton-hull ashes.

Massachusetts Hatch Station, Meteorological Bulletin No. 22, October, 1890 (pp. 4).

A daily and monthly summary of observations for October, 1890, made at the meteorological observatory of the station, in charge of C. D. Warner, B. S.

Michigan Station, Bulletin No. 65, August, 1890 (pp. 7).

SPECIAL PLANTING FOR HONEY, A. J. COOK, M. S. (illustrated).—It is well known that owing to peculiar conditions of the weather even the best honey plants sometimes fail to secrete nectar or produce blossoms. There are also times in every season and region, as in Michigan from July 15 to August 15, when there is a dearth of nectar-secreting flowers. Waste places, near apiaries, such as are found along roads and railways, might be utilized if the right kind of honey plant for planting there could be discovered. For the past two seasons this station has devoted about 14 acres of land to investigations in this line. "The seasons have been very opportune, as there was an almost total failure in the honey harvest both years, and so if any plan adopted was a success, it would have ample chance to prove its excellence." The plants experimented with were "Rocky Mountain bee plant (*Cleome integrifolia*), Chapman honey plant (*Echinops sphærocephalus*), and a foreign mint of the genus *Melissa*." Four or five acres, part clay and part sandy soil, were sown with the Chapman honey plant. The plants made a vigorous growth, but did not blossom until the second season. After bearing a full crop of seed the plants seemed exhausted and few survived to blossom again, though young plants came up thickly from the self-sown seed. The seed sown on five acres in the spring of 1890 almost entirely failed to germinate. Another objection to this plant is that the chaff has minute barbed awns, which severely wound the skin and eyes of the persons who clean the seed.

The Rocky Mountain bee plant sown in 1888 and 1889 did not germinate well on either sandy or clay land, and the flowers produced did not secrete nectar freely. "The melissa is an annual. We planted it for two successive years. It did well, blossomed freely, and was visited very generally by the bees. It grows well on both sand and clay, and by sowing early will commence to bloom early in July and continue in bloom for a month or more. I regret to say that it will not self-seed and must be planted annually. This is expensive and it is doubtful if it will pay." The author thinks that one of the perennial mints might be found more serviceable and hopes to make experiments with some of these mints in the future.

Michigan Station, Bulletin No. 66, September, 1890 (pp. 8).

FIGHTING THE PLUM CURCULIO, A. J. COOK, M. S.—This paper was read in substance before the Association for the Promotion of Agricultural Science, at Indianapolis, August 19, 1890. It includes a brief account of the life history of the curculio and a discussion of different methods for its repression. The author's observations and experience, confirmed by inquiries among fruit growers of Michigan, lead him to believe that the curculio has such a decided preference for the plum that if plum-trees are planted near other fruit trees the latter will be

very largely protected against the ravages of this insect. Experiments with a mixture of carbolic acid and lime (1 pint of the crude acid to 50 pounds of newly slaked lime) applied to plum-trees while the dew was still on them indicated that this is not a reliable remedy. Spraying with arsenites has also proved unsatisfactory in the experience of the author. The trapping of the insects by putting pieces of bark or chips close about the base of the tree trunk, under which the beetles hide and can thus be collected and killed, and letting poultry or even hogs or sheep run in the orchard, are recommended as methods of repression worthy of trial. But the old method of jarring the trees sufficiently to cause the insects to drop on a sheet held underneath is after all considered by the author to be "the surest, cheapest, and best method to banish the curculio and save our plums."

New Jersey Stations, Bulletin No. 71, August 14, 1890 (pp. 12).

ANALYSES OF INCOMPLETE FERTILIZERS, AND THE VALUE OF HOME MIXTURES, E. B. VOORHEES, M. A.—The bulletin contains fifty-two analyses of incomplete fertilizers, including nitrate of soda, sulphate of ammonia, dried and ground fish, tankage, dried blood, cotton-seed meal, cotton-hull ashes, bone-black, bone ash, dissolved bone, South Carolina rock and other mineral phosphates, muriate and sulphate of potash, kainit, sylvanit, ground tobacco stems, and waste from a cigar manufactory, the samples being taken from goods in the hands of farmers. The actual cost per pound of the nitrate, phosphate, or potash furnished by the above materials, and the differences between the manufacturers' retail prices for these materials and those of the New Jersey Station, according to the schedule for 1890, are brought out.

"Superphosphates are now often sold on what is termed the unit basis; the unit means 1 per cent per ton, or 20 pounds. For example, a quotation of $1 per unit of available phosphoric acid would mean $1 for each 20 pounds contained in the material. Contracts on this basis are perfectly fair for both buyer and seller, though it is quite as necessary to establish by analysis the number of units per ton as to determine the amounts contained when guaranteed on the per cent basis."

The composition of three "home mixtures" is given, together with comparison of their cost to the farmers by whom they were mixed, with the valuation on the New Jersey Station schedule of prices. These show that in buying unmixed materials and mixing at home "(1) there is a decided saving in the cost of plant food; (2) that the rate of saving depends upon whether the farmer is now an average buyer of complete fertilizers, buying at random, or whether he selects his brands from those manufacturers who furnish the most and best materials for the least money."

New Jersey Stations, Bulletin No. 72, October 4, 1890 (pp. 27).

PLANT-LICE AND HOW TO DEAL WITH THEM, J. B. SMITH (illustrated).—"During the spring and summer of 1890 plant-lice of all species were excessively common and injurious. They infested wheat, cabbages, peach and cherry-trees, melons and other cucurbitaceous vines, orchard grass, clover, roses, and chrysanthemums.

"Fortunately the same climatic conditions which favored the unusual development of the lice favored also the propagation of the fungoid diseases, which, however, attacked the species very unequally. The pests on orchard grass and on clover were carried off in masses, so that their destruction may be attributed principally to this feature. The wheat louse suffered more from parasitic attack and from the attacks of predaceous species. The peach and cherry species were quite exempt from both parasites and disease, while the melon louse seems to have been parasitized quite extensively."

This bulletin includes general statements regarding the *Aphididæ*, accounts of injuries committed the present season in New Jersey, descriptions of the insects and their life history, accounts of parasitic and other natural enemies, and suggestions regarding remedies for the following species: wheat aphis (*Siphonophora avenæ*, Fab.), cabbage aphis (*Aphis brassicæ*, Linn.), black peach aphis (*Aphis persicæ-niger*, E. F. Smith), cherry aphis (*Myzus cerasi*, Fab.), and melon aphis (*Aphis cucumeris*, Forbes). The article is illustrated with sixteen figures.

New Jersey Stations, Bulletin No. 73, October 6, 1890 (pp. 19).

ANALYSES AND VALUATIONS OF COMPLETE FERTILIZERS, E. B. VOORHEES, M. A.—"The chemical analysis of the commercial fertilizers sold in the State was assumed by the station on its establishment in 1880. In that year 64 samples were analyzed, of which 31 were complete fertilizers, representing the product of 21 manufacturers. Of the 540 samples received in the laboratory this year, 206 represent the different brands of complete fertilizers of 61 firms." The chief causes of this increase are—

(1) Demands for special crop fertilizers; (2) the increasing number of small factories; (3) a growing tendency on the part of large dealers to have goods prepared according to their own formulas; (4) the increased efficiency of the system of inspection adopted by the station in 1881.

That the multiplication of brands is not desirable is no longer a question; the number examined in 1880 would have been sufficient to cover all the special crop and soil requirements of the State, quite as well as the large number now demanding the attention of the farmer. The quality of the fertilizers and the quantity applied are more important factors in increased crop production than slight variations in the relative proportions of the nitrogen, phosphoric acid, and potash contained in them.

Tabulated results of the analyses of 126 complete fertilizers are given. A comparison of these with the manufacturers' guarantees of the

amounts of nitrogen, phosphoric acid, and potash contained in the fertilizers shows that "70 do not reach their claim in respect to one or more elements; 2 only are below guarantee in all respects. In 35 cases the deficiency is counter-balanced by an excessive amount of some other valuable ingredient; of the remainder many are so near as to make the difference hardly appreciable when expressed in dollars and cents. While there is still evidence of irregularity in mixing and carelessness in statement of guarantee, no attempt at deliberate fraud has been discovered."

New Jersey Stations, Bulletin No. 74, October 21, 1890 (pp. 12).

GROUND BONES AND MISCELLANEOUS SAMPLES, E. B. VOORHEES, M. A.—"The results here published complete the fertilizer work of this year, and include the analyses of 31 samples of ground bone, 7 of dissolved bone, 4 of superphosphates with potash, and 6 of ashes."

A popular description is given of the action of ground bone, the influence of mechanical condition on its value, and its value as compared with that of complete commercial fertilizers.

"A study of the complete fertilizers examined this year shows that the nitrogen is derived chiefly from organic materials; that more than one fourth of the available phosphoric acid is what is termed reverted and similar in form to that existing in bone of the first grade; and that the average cost per pound of nitrogen is 21.8 cents, and of phosphoric acid, 10.2 cents [at prices existing in New Jersey].

"It remains for the farmer to decide whether for his soil and his crops it is always more profitable to buy nitrogen for 21.8 cents and phosphoric acid for 10.2 cents per pound in the form of complete fertilizers, when the same elements can be bought in ground bone for 12.5 cents and 5.4 cents per pound. In other words shall the dollar spent for fertilizers buy 8 pounds of nitrogen or 4½ pounds? Shall it buy 10 pounds of phosphoric acid or 18½ pounds? * * * The superphosphates with potash are simply mixtures, and possess no special advantages. With one exception excessive charges are made for work of mixing, which the farmer is capable of doing quite as well himself."

New York State Station, Bulletin No. 22 (New Series), August, 1890 (pp. 11).

PIG-FEEDING EXPERIMENTS WITHOUT MILK, P. COLLIER, PH. D. (pp. 285–295).

Results with corn silage.—The experiments were made in response to inquiries as to the value of silage for feeding pigs. Sixteen pigs, 8 Cheshires and 8 Duroc-Jerseys, were divided into four lots of 4 pigs, 2 sows and 2 barrows each, each lot being as nearly alike with regard to age, condition, and average weight as practicable. "All of the pigs were given nearly enough of bran and middlings for sustenance, and some were fed silage in addition as they would eat or chew over, while others, at the same time, were fed in contrast corn on the cob."

The experiment extended from December 19 to May 9, nearly five months, and was divided into four periods of five weeks each. Lots 1 and 3 received corn during the first two periods, silage and corn during the third, and silage alone the fourth. Lots 2 and 4 received silage the first period, silage and corn the second, and corn alone the third and fourth periods. The following statement summarizes the plan:

	Period 1.	Period 2.	Period 3.	Period 4.
Lots 1 and 3	Corn	Corn	Silage and corn	Silage.
Lots 2 and 4	Silage	Silage and corn	Corn	Corn.

Thus the effects of silage alone or silage and corn were alternately compared with those of corn on each two lots of pigs during each half of the experiment, the rations being so arranged that the transition from silage alone to corn alone was gradual, and *vice versa*. All the animals received the same average amounts of wheat bran and middlings in addition to the silage or corn during the whole trial.

"The silage was of superior quality, finely cut, and made from corn ripe enough to cut for husking. * * * The silage was never all swallowed even when fed in very small quantities, although after the grain had been eaten out the remainder was chewed. It was not possible during this trial to separate and determine the amount not swallowed; so, although the figures show the amount fed, they are not absolute as regards the amount eaten, but are, however, approximate and comparative."

The average dry matter eaten, gain in live weight, dry matter eaten per pound of increase, gross and net cost of same, and value of the manure, calculated for 100 pounds of live weight per day, are stated in tabular form. The calculated cost of the rations fed is based on wheat middlings at $20, wheat bran and corn at $16, and silage at $1 per ton. The pork was valued at 4¼ cents per pound, live weight.

Averages per day calculated for each 100 pounds of live weight.

	Water-free food eaten per day.	Water drunk per day.	Gain in live weight per day.	Water-free food eaten per pound of gain in live weight.	Gross cost of feed per pound of gain in live weight.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*
Average for all with silage	2.62	7.90	0.37	7.08	4.65
Average for all with corn and silage	2.71	6.56	0.62	4.37	3.73
Average for all with corn (no silage)	2.78	6.81	0.74	3.76	3.77

"The results show that with silage rated so low as $1 per ton the gross cost for production of pork was considerably more than its market value when the proportion of silage was about 70 per cent of the

ration." When corn took the place of part of the silage, the silage forming an average of 44 per cent of the total food, the gross cost of pork was about the same as where no silage was fed. "Although the moisture in the silage ration was six times as much as in the grain ration, the animals drank with it 7.9 pounds of water a day as average for 100 pounds of pig (live weight) and 6.8 pounds of silage."

Rations with and without salt.—Two lots of pigs, each containing one Cheshire and one Duroc Jersey, were fed from March 20 to July 10 on similar rations, except that one lot received a small amount of salt each day and the other none. The rations, consisting of grain and either silage, prickly comfrey, or silage and comfrey together, were nearly the same in amount for each lot, except that when comfrey was fed the lot receiving salt consumed considerably more of the green food. The results of the trial are stated in a table. "The lot having salt showed the better gains under every ration, although only under the grain ration did they make a profitable growth. While under grain food only they drank more water, but while having a more succulent ration during warmer weather, they drank very much less than those without salt. While prickly comfrey was fed the pigs without salt required 52.8 per cent more water-free food for a pound of gain, the cost being 55.7 per cent greater than with salt, neither lot making a profitable growth, however."

Feeding prickly comfrey.—During three weeks pigs averaging about 64 pounds each in weight, were fed all the chopped comfrey they would eat, receiving no other food except about 5 ounces of corn meal each daily. They refused to eat more than about 3 pounds of comfrey each per day, and lost 0.9 to 1.6 pounds in live weight per animal each week of the trial.

New York Cornell Station, Bulletin No. 20, September, 1890 (pp. 13).

CREAM RAISING BY DILUTION, H. H. WING, B. AGR., AND C. D. SMITH (pp. 61–67).—These experiments were made to compare the separation of the cream by two methods, one with ordinary Cooley creamer cans set in ice water, and the other by diluting the fresh milk with water of different temperatures and setting it in deep cans without ice. The milk was in all cases mixed milk of the university herd, consisting of about two thirds high grade Holstein and one third high grade Jersey cows. The analyses were made by H. Snyder, assistant chemist.

Eleven comparative tests were made in which mixed milk from the same milking was divided into two portions, one part being diluted with an equal weight of cold water (47 to 60° Fah.) and set in a Cooley can in an open room having a temperature of 60 to 66°, and the other part set at once in ice water in the Cooley creamer, the time of setting being the same in all the cases but two. The milk taken was in some cases freshly milked, in others "had been carried on the milk route for

about an hour and a half." In the cases in which water had been added the percentages of fat found in the skim-milk from each setting were corrected to allow for the water added. Where the milk was diluted with cold water and set in an open room the skim-milk contained from 1.04 to 1.58 per cent and averaged 1.28 per cent of fat, or nearly six times as much as where the Cooley creamer and ice were used (0.23 per cent of fat). "In other words, while 95.18 per cent of the whole milk was recovered in the cream when set in the Cooley creamer in ice water, but 69.18 per cent of the fat in the whole milk was recovered in the cream when set in the diluted process."

In ten trials the milk was diluted with from 10 to 100 per cent of hot water (temperature 120 to 136° Fah.), the cans being set in the air at 59 to 72° in four cases, and in running water at 60 to 61° in the other six cases, and all skimmed after twenty-four hours standing. The general average was slightly better than where cold water was used, the skim-milk containing about 0.17 per cent less of fat, although several factors which may have affected the results, other than the temperature of the water, were introduced. Thus in six cases where the milk was set in running water the skim-milk averaged 0.25 per cent of fat less than in the four cases where it was set in the air, and the variations in the skim milk for the individual samples were nearly twice as large as in the previous trials. "In all cases in which hot water was added the milk was sour, or very nearly so, at the end of twenty-four hours, and in some cases souring had gone so far that the cream was much injured for butter making." Reference is made to similar experiments at the Vermont Station in which milk set at 58° and diluted with one third its volume of hot water gave a skim-milk containing only 0.35 per cent of fat.

Six trials in which from 20 to 50 per cent of cold water (52 to 54°) was added and the cans set, in four cases in the air at 60 to 72°, and in two cases in running water at 63 to 64°, the skimming being done after twenty-four hours standing, gave results varying from 0.78 to 1.76 per cent of fat in the skim-milk, the average of the four samples set in the air being 1.38 per cent and of the two set in running water 0.95 per cent. The general average, 1.24 per cent, was, however, the same as in former trials where 100 per cent of cold water was added.

In two trials in which undiluted milk was set in Cooley cans in running water at 60 to 63° the skim-milk averaged 0.89 per cent of fat. Milk was set in shallow pans and skimmed, in one case after forty-eight hours, and in two others after twenty-four hours, one of the latter samples having been diluted one third, by weight, with water at 120°. Twenty-four hours seems to have been sufficient for the separation of the cream; but the skim-milk, where the milk had been diluted before setting, was 0.27 per cent higher in fats. "Setting in shallow pans without the addition of water gave much better results than any other system, except deep setting in ice water." Five churn tests were made

with cream raised under different conditions. The yields of salted and worked butter corresponded in general with the result of the analyses of skim-milk, and are here given.

	Milk set in Cooley creamer in ice water.		Milk diluted with cold water and set in the air.		Milk set in shallow pans.
	Pounds.	*Pounds*	*Pounds*	*Pounds*	*Pounds.*
Pounds of milk required for one pound of butter...	21.31	19.63	36.54	34.01	24.03

Experiments by Martiny and Peters are cited, the results of which "in general coincide with our own except that in the second of the two trials closer results were obtained as between the two methods than in any of ours."

VARIATIONS IN FAT OF MILK SERVED TO CUSTOMERS IN DIPPING FROM CANS, H. H. WING, B. AGR., AND C. D. SMITH (pp. 68–71).—It has been asserted that injustice is done to consumers by milkmen dipping the milk from the top of the can or drawing it by a faucet at the bottom, in that the cream rises to the top of the can and is given to the customers served first, so that those who are served last get a milk with little fat. To determine the variations in the percentage of fat in milk served to different patrons along the route by dipping from the can, milkmen were accompanied at three different times and samples of the milk as it was about to be served taken for analysis, at least three different samples being taken from the same can at different times. The milk was in each case the mixed milk of herds.

It would seem from the duplicate gravimetric analyses that "where milk is peddled by dipping from the can with an ordinary dipper, and where no stirring is done except by the motion of the wagon and raising the dipper, substantial justice is done all the patrons so far as the amount of fat apportioned to each is concerned. This conclusion seems the more justified as each trial was made on a different milk route, and represents the usual custom of three different milkmen, since each man was cautioned at the beginning to in nowise depart from his ordinary practice."

North Carolina Station, Bulletin No. 71, May 15, 1890 (pp. 31).

CO-OPERATIVE FIELD TESTS DURING 1889, H. B. BATTLE, PH. D. (pp. 3–28).—A series of co-operative experiments similar to those made by the station in 1888 was made on farms in fourteen different counties of the State, nine trials being with cotton and five with corn. In general twenty-two twentieth-acre plats were used in each experiment, acid phosphate, cotton-seed meal, and kainit being applied in different quantities, singly on six plats, two by two on six plats, and all three together in "complete fertilizers" on four plats, two plats being fertilized with barn-yard manure or compost, one with "North Carolina am-

moniated fertilizer," and three remaining unmanured. Acid phosphate was used at the rate of 300 to 400 pounds per acre alone, 200 to 300 pounds with one other material, and 100 to 300 pounds in the complete fertilizer; cotton-seed meal, 400 to 500 pounds alone, 100 to 250 pounds with one other material, and 100 to 200 pounds in the complete fertilizer; and kainit at the rate of 300 to 400 pounds alone, 150 to 250 with one other material, and 50 to 200 pounds in the complete fertilizer. The directions sent out by the station were in general not closely followed. The number and width of rows, the spaces between the plats, and the area for which the results were calculated, varied widely. The experimental fields selected seemed on the whole to be tolerably even in fertility. The season was very unfavorable for all crops, a frost in October reducing the cotton crop by one third or one half and in some cases as much as two thirds; while corn, except on the lowlands, was badly damaged. The fertilizers applied, yields, and increased yield over unfertilized plats are tabulated for each experiment.

Results of experiments with corn.—"The result is more favorable than for 1888. Then the applications, with but few exceptions, proved unremunerative. For this season a much larger number yielded good returns. * * * Without exception, cotton-seed meal, in both large and small applications, increased the yield materially and proved remunerative. This effect extended to the combination of meal with other ingredients. Acid phosphate alone, in all cases except one, only slightly increased the yield, and proved unremunerative. In combination with meal the result was better, but with kainit the yield was not sufficient to be remunerative. Kainit alone was generally quite unsatisfactory in both large and small applications. The complete fertilizers, represented by Nos. 3 and 13 [200 or 300 pounds acid phosphate, 100 or 150 pounds cotton-seed meal, and 50 or 70 pounds of kainit], in the main proved satisfactory."

Results of experiments with cotton.—The author believes that the following deductions from this year's results may be safely made:

Applications of fertilizing material, notwithstanding the wet season and other difficulties, were profitable, with but few exceptions. Acid phosphate used alone has proved profitable in a majority of cases, which agrees with the result of last year. Cotton-seed meal used alone has proved remunerative in both large and small applications, verifying the favorable impression made last year. The experience with kainit this year has been the same as last, and verifies the estimate placed upon it at that time. It has proved unprofitable. Stable manure has proved beneficial. Twenty two-horse loads per acre have increased the yield materially; but, considering the cost, the smaller application of 10 two-horse loads per acre is more remunerative. * * * [As in 1888] next to stable manure the best application for this season for the average soil appears to be a combination of the three ingredients—available phosphoric acid, nitrogen (or ammonia), and potash. The best proportion of these ingredients was 200 pounds acid phosphate, 100 pounds cotton-seed meal, and 50 pounds kainit to the acre of average soil. Where the land is poor this application per acre might well be increased in the same proportion.

WHEAT, TESTS OF VARIETIES, H. B. BATTLE, PH. D. (p. 15).—Tests of twelve varieties of wheat on twentieth acre plats, sown November 10,

at the rate of 1 bushel per acre. The varieties giving best results in this trial were Lancaster, Fulcaster, Everett High Grade, which yielded 16.7 to 17 bushels, and Kivet, which yielded 15 bushels per acre.

HILLSIDE DITCHES, J. R. CHAMBERLAIN, B. S. (pp. 29–31).—The broad ditch made by means of a plow is advocated, and directions for its construction are given and illustrated by cuts.

North Carolina Station, Bulletins Nos. 68a, 68b, 68c, 69a, 69b, 70a, 72a, 72b, 72c (Meteorological Bulletins Nos. 1–11), November, 1889, to September, 1890.

METEOROLOGICAL SUMMARY FOR NORTH CAROLINA, H. B. BATTLE, PH. D., AND C. F. VON HERRMANN.—These contain notes on the weather and tabulated summaries of meteorological observations by the North Carolina weather service, co-operating with the United States Signal Service, for each month from October, 1889, to August, 1890, inclusive. The bulletins are illustrated with maps of North Carolina, showing the isothermal lines and the total precipitation for different parts of the State. Bulletin No. 72*a* also contains tabulated notes on the tornadoes observed in North Carolina during the past sixty-five years (1826–90), and Bulletin No. 72*c* includes a brief compiled article on the formation and classification of clouds.

Ohio Station, Bulletin Vol. III, No. 7 (Second Series), August, 1890 (pp. 18).

STRAWBERRIES, W. J. GREEN (pp. 209–222).—"Since the organization of the horticultural work of the station a leading feature has been the testing of varieties of strawberries." An attempt has been made to enlarge this work by sending out plants of new sorts for trial by fruit growers in different localities. The results of this plan have been so unsatisfactory that the practice will be discontinued except in cases where satisfactory reports can be assured or where the station can exercise proper supervision. "Experience shows that to reduce the number of varieties to the lowest limit, to increase the size of the plats, and to multiply tests is the direction in which to work. These changes have been made or are being made as fast as possible. To more sharply define the limits of each experiment or trial of varieties, will be the aim; *i. e.* varieties will be so tested as to determine one or two special characteristics, such as comparing for earliness, lateness, productiveness, etc., and to bring these points out prominently, rather than to study all equally closely. A thorough comparison of early varieties and of the productiveness of several leading varieties is now in progress. It is hoped that with the strawberry at least variety testing, as commonly understood, may be largely discontinued, and no harm done to the interests represented. New varieties, not yet offered for sale, will be tested as heretofore."

There is also a discussion of the essentials of a good variety of

strawberries, descriptive notes for 41 varieties, tabulated notes on date of first picking, weight of 100 berries, and average diameter of berries for 17 varieties, and some general observations on different classes of varieties. "If varieties of strawberries are separated into two classes, viz., those that continue a long time in bearing, and those that have a short season, it will be found that the most prolific fall into the first class and the least productive into the second. It is also true, in general, that the greater the number of pickings during the season, the greater the total product. * * * Nearly all of the very early varieties continue but a short time in bearing, give comparatively few pickings and produce light crops. The same is true, in a more marked degree, of the extremely late-ripening sorts. * * * In general, the medium or second-early sorts are those having a long season. Although not all that are found in this class are highly fruitful, it is true that the most fruitful come within it."

Eight each of the leading perfect and imperfect-flowered varieties of strawberries were sent to several prominent strawberry growers, with a request to mark the different varieties as to productiveness on a scale of 10. The averages for each variety and for the two classes are tabulated in the bulletin and agree very closely with the varieties previously established at the station. The average for the perfect-flowered varieties is 5.8, and for the imperfect-flowered varieties 8.

"There can be no doubt that the production of pollen is an exhaustive process, hence the varieties having perfect flowers are at a disadvantage. No doubt some of the perfect-flowered sorts are very nearly equal to any in fruitfulness, and under certain circumstances may be fully equal, but the chances are against them when unfavorable conditions occur. * * * In many respects it may be desirable to have varieties with perfect flowers only, but it is probable that future development will be along the line of still greater specialization. The highest development of fruit-bearing qualities in one class and of pollen-bearing in the other gives promise of greater reward than to combine the two functions in one variety."

The following summary is taken from the bulletin.

(1) To meet the wants of strawberry growers a variety ought to have sufficient health and vigor to adapt itself to widely varying conditions and to possess one or more marked characteristics. It is not worth while to seek to find varieties that are adapted to particular soils, since varieties that have a limited range are generally found to be variable and untrustworthy. The most valuable varieties are the least variable and are easily suited as to soil and climate.

(2) The following varieties have been thoroughly tested and are suited to the wants of those who grow berries for market: Bubach, Eureka, Haverland, Crescent, Warfield.

(3) Where large berries are desired rather than quantity, the following can be recommended for home use or for market: Cumberland, Crawford, Gandy, Louise, Lida, Miami, Pearl.

(4) The new varieties that seem to be the most promising are Enhance, Farnsworth, Ivanhoe, Middlefield, Muskingum, Michel's Early, Parker Early, Shuster's Gem, Waldron.

(5) Those that have good points, but are doubtful and need further testing, are Cloud, Lady Rusk, Stayman's No. 1, Daisy.

(6) The following will no doubt be dropped soon: Hoffman, Jessie, Logan, Pineapple.

(7) The most productive varieties are those that have a long season, *i. e.* give a comparatively large number of pickings.

(8) Very early and extremely late varieties are less fruitful than the medium early.

(9) Perfect-flowered, as a rule, are less productive than the pistillate or imperfect-flowered varieties.

RASPBERRIES, W. J GREEN (pp. 222, 223).—"There have been no such changes in the relative standing of varieties of raspberries within the last few years as with strawberries. The varieties that were recognized as standards five years ago hold the same place still, although several new sorts are now quite generally accorded the same rank. * * * Judging from the varieties sent here for trial there seems to be a strong tendency in some varieties to reproduce themselves from seed. This is particularly true of the Gregg and Doolittle. The majority of black-cap seedlings sent here are referable to one or the other of the above types, and in many cases the resemblance is so close as to make distinction impossible."

Descriptive notes are given for five of the newer varieties. The following summary is taken from the bulletin:

(1) The black-cap varieties that are now considered the most reliable are as follows: Gregg, Hilborn, Ohio, Palmer.

The red sorts that succeed best generally are Turner and Shaffer: the best for shipping are Brandywine and Marlboro.

(2) Muskingum, Royal Church, and Thompson's Early Prolific are the most promising of the newer varieties.

Ohio Station, Bulletin Vol. III, No. 8 (Second Series), September, 1890 (pp. 18).

EXPERIMENTS IN PREVENTING THE INJURIES OF THE PLUM CURCULIO, C. M. WEED, D. SC. (pp. 225–228).—This is a third report on a series of experiments begun in 1888 to find out the best method of preventing the injuries of the plum curculio (*Conotrachelus nenuphar*). For the first report see Annual Report of Ohio Station for 1888, pp. 134–150; for the second see Ohio Station Bulletin, Vol. II, No. 6 (second series), p. 133, and Experiment Station Record, Vol. I, p. 290. The experiments of 1888 and 1889 were conducted at the station, and indicated that the insect may be controlled by spraying with Paris green or London purple, where there are a considerable number of trees to operate upon. The objections urged against this conclusion were: (1) that while spraying might be effectual on a small scale it would be impracticable in a region largely devoted to fruit production; (2) that the tests made in the plum orchard were not extensive enough to show whether spraying would meet the needs of the commercial orchardist; and (3) that "the cherries, upon which some of the experiments were conducted, ripened before the season of egg deposition of the curculio was over." The force of these

objections was felt while the experiments were in progress, and they were made with the expectation of giving this method a thorough trial from the standpoint of the commercial orchardist if these preliminary tests were sufficiently encouraging. The theory on which the method rests, and the conditions necessary for a fair field trial are stated to be as follows:

The remedy undoubtedly acts mainly by destroying the adult beetles that feed upon the poisoned surface of the fruit and foliage, thus preventing, to a greater or less extent, the deposition of the eggs. It need not necessarily act at all upon the beetles when engaged in oviposition, nor upon the larvæ after hatching. Consequently a fair test can not be carried on with a half dozen trees close together, three of which are sprayed and the others not. Beetles from the unsprayed trees may oviposit in the fruit of those sprayed, and the beetles killed on the sprayed trees will lessen the injury to their checks. For the same reason a fair test can not be carried on in an orchard in which only every alternate tree is sprayed. A conclusive experiment necessitates an orchard of considerable size, one half to be sprayed and the other half either to be jarred or left untreated, or else two orchards near together with a similar difference in treatment.

For the purpose of a thorough test an orchard of nine hundred five-year-old plum-trees, near Gypsum, Ottawa County, Ohio, in the midst of a region where fruit is extensively grown, was placed at the disposal of the station. "The orchard was admirably adapted for a fair field test of the method, and contained about ten varieties of plums. An imaginary line was drawn through the middle of the orchard east and west, and the south part was reserved for spraying, while the north half was jarred." Pure Paris green, mixed with water in the proportion of 4 ounces to 50 gallons, was sprayed on the trees in the south half of the orchard May 8, 15, and 26. June 2 a fourth application was made, but by mistake 4½ instead of 4 ounces of Paris green was used with each 50 gallons of water. The north half of the orchard was jarred from May 6 to June 7, and many curculios were thus obtained. During the latter part of June the foliage of some varieties began to show injuries due to the Paris green. "Not over 3 per cent of the sprayed fruit had been stung at that time, while about 4 per cent of that on the jarred trees had been injured. But on both the fruit was so thick that artificial thinning was necessary to prevent the trees from overbearing." In July and August the jarred portion of the orchard suffered from attacks of the plum-leaf fungus (*Septoria cerasina*) and brown rot (*Monilia fructigena*), while the sprayed trees wholly escaped the former and were comparatively free from the latter. "So far as one experiment can be relied upon, it indicates that this method is as efficient as jarring, while it is vastly cheaper and easier of application. We hope to repeat the experiment another season, and shall use, at least for the later sprayings, not over 3 ounces of pure Paris green to 50 gallons of water, hoping thus to avoid injury to foliage."

Remedies for the striped cucumber beetle, C. M. Weed. D. Sc. (pp. 229–231, illustrated).—In 1889 experiments were made at this

station with a number of remedies for the striped cucumber beetle (*Diabrotica vittata*), and the results were reported in the Ohio Station Bulletin, Vol. II, No. 6 (second series), pp. 143–148 (See Experiment Station Record, Vol. I, p. 290). Experiments in this line were continued in 1890 in a field of 2 acres planted to squashes, melons, and cucumbers. "The first striped beetles appeared June 5. They then came in great numbers and destroyed at least half the plants above ground before the latter could be treated. Two general methods of treatment were employed, viz.: (1) coating the plants with poisonous substances; and (2) fencing out by mechanical barriers." Results are reported for six substances applied to the plants, viz., "hellebore, slug shot, Paris green, X. O. dust, peroxide of silicates, and tobacco. On account of frequent rains that washed the powders off the applications were often repeated." The first four were ineffectual and "peroxide of silicates" was only partially effective. The report for tobacco is as follows: "A number of barrels of tobacco dust packing from a cigar manufactory were obtained in the city and applied very freely to the squash hills. A shovelful of the tobacco was thrown upon each hill. The first application was made to eighty hills June 12. Rains coming soon after, it was repeated June 15, 16, and 17. The results were excellent. The beetles seemed to dislike working in the tobacco, and the plants on all of the hills treated came through in good condition. Aside from its value as an insecticide the tobacco acts both as a mulch and fertilizer."

Covering the plants with plant or cheese cloth supported on pieces of barrel hoops, proved satisfactory this year as last. A modification of this method successfully used by R. J. Tussing, of Franklin County, Ohio, is thus described:

It consists of two end boards one half inch thick, about 15 inches long by 6 or 8 inches wide. On the middle of each of these is nailed a piece of pointed lath at right angles to the long way of the board. The lower end of each lath projects below the edge of the board and is stuck in the ground. Before the laths are put on, the end pieces are connected with each other by a piece of plant cloth about 16 inches square, the ends being tacked to the top and sides of the boards. This protector has many advantages. It can be stored in very little space. When it is desired to cultivate the hills it is only necessary to pull up one end, stir the earth, and put the end back in position.

Open frames, consisting of four boards nailed together, were tried, but as was anticipated, were entirely ineffective.

ON THE LIFE HISTORY OF THE RHUBARB CURCULIO, C. M. WEED, D. SC. (pp. 232–235, illustrated).—In Ohio Station Bulletin, Vol. II, No. 6 (second series), p. 153 (See Experiment Station Record Vol. I, p. 291), attention was called to injury to rhubarb by a snout beetle (*Lixus concavus*, Say). "The egg is there described, but the further life history of the insect is said to be unknown." In the present article we have brief mention of other literature regarding this insect and a report of observations made by the author in 1890. Curculionid larvæ were found on the curled dock (*Rumex crispus*) July 15 and 16, and larvæ

and pupæ in abundance July 24, at which time they were placed in vivaria. Two adults of the rhubarb curculio emerged August 1. On the same day two adults, sixteen pupæ, and sixteen larvæ were found on the curled dock. September 2 an adult was found on a leaf of curled dock, and October 2 another was taken in a cavity of the root where it had evidently developed.

The same day three pupæ were found in similar situations. In these cases the plant was of this year's growth, not having sent up a flower stalk, so that the insects must have developed within the root alone.

The earlier observations of the season showed the larvæ usually boring the flower stock and upper portion of the root. As a rule, only one insect was found in a stem, but there were occasional exceptions to it. Pupation took place at almost any point from the base of the cavity in the root to the upper portion of the stem. No indications of the girdling of the stem were noticed, and late in September large numbers of the dead stems, which had been inhabited by the insect, were still standing. In many of them a hole could be found through which the beetles had emerged. These holes occurred at almost any point on the stalk.

I have also repeatedly collected the perfect insect during the autumn, winter, and spring months, not only in Ohio but also in Illinois and Michigan.

From the above observations it appears that in this region the rhubarb curculio usually hibernates as an adult, and comes forth in the spring to deposit its eggs in certain common species of dock (usually in *Rumex crispus*, but occasionally also in *R. altissimus* and probably other species). The eggs are probably laid preferably in the young flower stalk, but in the absence of these may be deposited in the crown of the plant. The period of oviposition is evidently an extended one, very young larvæ being taken at the same time as pupæ, and there being a difference of more than two months in the time of reaching maturity. The eggs probably hatch within a few days, and the larvæ feed upon the substance of the root or stem several weeks. The eggs first deposited in spring develop into beetles by the 1st of August, and the insects from eggs deposited later continue to mature until October.

The insect in its different stages is briefly described and is illustrated by original cuts. A parasite of the rhubarb curculio, identified by Prof. Riley as *Bracon rugator*, Say, was also found and is illustrated. The destruction early in summer of the plants in which the rhubarb curculio develops is recommended for its repression.

A SECOND EXPERIMENT IN PREVENTING THE INJURIES OF POTATO BLIGHT, C. M. WEED, D. SC. (pp. 239, 240).—In Ohio Station Bulletin, Vol. II, No. 6 (second series), p. 157, (See Experiment Station Record, Vol. I, p. 291), was recorded a preliminary test in which a considerable increase of yield was obtained from treating what is commonly known as the blight or rot of potatoes with the Bordeaux mixture. At that time the disease was thought to be due to *Phytophthora infestans*, but the author is now inclined to believe that it is the bacterial disease referred to in a recent paper by Prof. T. J. Burrill, read before the Society for the Promotion of Agricultural Science. In 1890 five rows of Early Ohio potatoes were treated with Bordeaux mixture, four rows with ammoniacal solution of carbonate of copper, and two rows were left untreated. The fungicides were applied June 28, July 7, July 17, and August 1. When the potatoes were harvested "the rows sprayed with the Bordeaux mixture averaged 40.2 pounds to the row; those

sprayed with the carbonate of copper solution, 28 pounds; and those untreated, 22.5 pounds. The tubers from the Bordeaux-mixture rows were much larger than the others." Lateness of planting, due to wet weather, and the dryness of the growing season, made the test comparatively unsatisfactory. In a case cited in the bulletin where the Bordeaux mixture was used on a large scale for this disease in 1890 on a farm in Ohio, the results were unfavorable.

"There is still much to be learned concerning this bacterial blight, and further experiments are needed to determine whether it can be successfully prevented on a large scale under ordinary commercial conditions by the use of fungicides, and whether this can be done with sufficient cheapness to pay for the additional outlay. One of the points that especially needs to be determined is whether non-infected tubers should not be planted to get the best results from the application of fungicides. This would be the natural supposition, and experiments are now in progress to determine the facts of the case."

Pennsylvania Station, Bulletin No. 12, July, 1890 (pp. 30).

SIMPLE METHODS OF DETERMINING MILK FAT, W. FREAR, PH. D., AND G. L. HOLTER, B. S. (pp. 3–31, illustrated).—A detailed description of the Short and Cochran methods for estimating the percentage of fat in milk, together with a comparison of the results of these and the gravimetric (asbestos) method. Of the mean of duplicate analyses of twenty-six samples of the milk of individual cows, 85 per cent by the Short method were higher and 81 per cent by the Cochran method were lower than those of the gravimetric. About one third of the determinations by the Short method differed by over 0.2 per cent from the gravimetric, the difference in three cases being 0.4 to 0.49 per cent of fat. By the Cochran method less than one quarter of the tests differed from the gravimetric by 0.2 to 0.3 per cent, and in only one case was the difference as high as 0.3 per cent. The average error for the twenty-six analyses was with the Short test +0.15, and with the Cochran −0.06 per cent. "In Short's method a somewhat closer agreement of duplicates is obtained than in Cochran's method, as would be expected from the finer subdivision of the apparatus and the greater quantity of milk used in the former. In general, however, Cochran's method seems somewhat preferable, owing to the greater rapidity with which single determinations can be made."

Tests by the Short method in which the solution was boiled only one half hour after the addition of the acid, gave practically the same results as where the boiling was continued for one hour, as prescribed, the mean difference of results between the prescribed and the modified methods being only 0.08 per cent in eleven cases, "while by the original method, comparing duplicates in forty-one analyses, the mean difference was 0.07 per cent." With the modified method "the fatty acids

are clearer, lighter colored, and more sharply separated from the underlying caseous liquid."

Tables show for the Short and Cochran methods the percentages of fat indicated by the readings of fatty acids. The station offers to give instruction in these methods free of charge to any who desire it.

Paying for milk and cream.—Tables of values of milk and cream per 100 pounds based upon the fat content, with instructions for their use.

DRIED BREWERS' GRAINS, W. FREAR, PH. D. (pp. 32, 33).—A discussion of this material, and analyses showing the feeding value of "wet" and dried grains as compared with that of malt sprouts, wheat bran, and linseed and cotton-seed meals.

Rhode Island Station, Bulletin No. 6, March, 1890 (pp. 23).

MILK FEVER OR PARTURIENT APOPLEXY IN COWS, F. E. RICE, M. D., M. R. C. V. S. (illustrated).—A condensed history of this disease, its pathology, causes, symptoms, diagnosis, preventive and curative treatment, and the effect of the disease on the flesh of cows as food.

Rhode Island Station, Bulletin No. 7, June, 1890 (pp. 39).

CATALOGUE OF FRUITS, L. F. KINNEY, B. S. (pp. 27–58).—A list of the varieties of orchard and small fruits, and nuts growing on the grounds of the station; with notes on habit of growth and time of ripening; and brief descriptions of most of the varieties. The list includes 15 varieties of summer apples, 19 of autumn apples, 48 of winter apples, 15 of crab-apples, 4 of apricots, 27 of cherries, 4 of nectarines, 40 of peaches, 12 of summer pears, 22 of autumn pears, 11 of winter pears, 31 of plums, 2 of almonds, 3 of chestnuts, 1 of figs, 1 of filberts, 1 of persimmons, 3 of quinces, 1 of black walnuts, 1 of butternuts, 13 of blackberries, 2 of dew-berries, 10 of currants, 7 of gooseberries, 85 of grapes, 2 of June-berries, 20 of raspberries, and 47 of strawberries.

METEOROLOGICAL SUMMARY, L. F. KINNEY, B. S. (p. 59).—A tabulated summary of observations from January to June, 1890, inclusive.

SPRING REPORT OF THE APIARIST, S. CUSHMAN (pp. 60–63).—Of the thirteen colonies of bees which passed the winter of 1889–90 out of doors all but the weakest one survived and were strong and ready for the honey flow early in the spring. Three hives containing two strong colonies and one weak one were placed in the farm-house cellar November 6, 1889. All the hives contained live bees April 1, 1890, but the weak colony was found "to have dwindled away to a handful." The temperature of the cellar during February and March ranged between 30 and 40° nearly two thirds of the time. "The past winter was very favorable to outdoor wintering, and any colony of good strength having plenty of sealed stores, even if unprotected, should have wintered well. * * * Had the winter been severe, with long-continued cold and a

backward spring, the bees in a suitable cellar would no doubt have shown the best record. * * * The importance of having colonies strong for winter and spring, in order to have them sufficiently populous to best improve the time during the honey harvest" is enforced by this experiment. The system of feeding bees with dry sugar, recommended by Mr. Simmins of England, was successfully tried by the author. "After several years' trial of the plan on a somewhat extended scale we do not hestitate to recommend it. It is well suited to the management of out apiaries, where but occasional visits are made, and in all cases, though possibly in a dry country not so effective as sirup feeding, saves the trouble of making sirup and the time required in its daily distribution, while the danger of the disastrous results of occasionally omitting the daily ration is avoided. Instead of dry sugar, moist sugar, like good grades of molasses and C sugar are best, but the former should first be well drained. This placed in a feeder where the heat and moisture are confined, is slowly licked up or liquefied by the bees. The rapidity with which this is done depends upon the heat and moisture in the hive. * * * This mode of feeding is not only suitable for spring stimulation but is invaluable in a poor season to prevent starvation, for queen rearing, for bringing up nuclei, and working for increase or drawing out foundation, as well as for promoting brood rearing, after removing what is in some localities the only honey crop of the season." An experiment in the use of artificial heat to promote brood rearing has been successfully conducted at the station, but will not be reported until additional results have been gained.

Tennessee Station, Special Bulletin D, July 10, 1890 (pp. 47).

POTASH AND PAYING CROPS.—A reprint of a compilation by the German Kali Works.

Tennessee Station, Special Bulletin E, July 20, 1890 (pp. 8).

THE COTTON WORM AND HESSIAN FLY, H. E. SUMMERS, B. S.—Directions are given for the application of the arsenites for the cotton worm (*Aletia argillacea*). The Hessian fly (*Cecidomyia destructor*) is described and illustrated, and suggestions are made as to means for its repression.

Texas Station, Bulletin No. 11, August, 1890 (pp. 16).

EFFECT OF COTTON SEED AND COTTON-SEED MEAL ON BUTTER, G W. CURTIS, M. S. A. (pp. 3–14).—The objects of these trials were to study the effect of cotton seed and cotton-seed meal, fed to dairy cows, on the butter produced, with regard to quantity and quality in general, and the extent to which these feeds may safely be mixed with other feeds.

Effect on body or firmness.—The determinations of melting point and volatile acids in the butters were made by H. H. Harrington and W.

Wipprecht. The results, which have already been published in the annual report of the station for 1889, are summarized in the following statement:

Averages of determinations of melting point and volatile acids.

	Melting point of butter.	Volatile acids in butter.
	°Fah.	*Per cent.*
Corn-and-cob meal, oats and bran, with silage, sorghum, pea-vine hay, and pasturage	95.33	15.27
Cotton-seed meal and hulls exclusively	105.44	10.15
Cotton seed exclusively, either raw or cooked	104.81	7.85
One weight part cotton-seed meal and three of whole oats, with sorghum hay and pasturage	99.17	13.14
Equal weight parts of whole oats and cotton seed, with pasturage	97.83	13.39

"It is clear that the melting point was higher and the percentage of volatile acids lower with cotton seed or cotton-seed meal than without." The inference is drawn that "firmness or body is largely dependent on the food." Although "all of the heavy feeding of cotton seed or cotton-seed meal must be done in cool weather on account of the health of the animal," it is believed that small quantities may be safely fed in summer, thus "hardening the butter slightly for summer handling."

Effect on quantity.—"In the test for exclusive feeding of cotton-seed meal and hulls, as compared with cotton seed, the cows fell off in milk quite materially, from the fact that it was practically impossible to get them to eat a sufficient amount for a full ration. * * * It has been our observation in some seven years' feeding at this place that by the addition of cotton-seed meal in moderate quantities to the daily feed, the yield of milk has almost always been directly increased." An experiment indicated that the quantity of milk required to make 1 pound of butter is somewhat less where cotton seed or cotton-seed meal is fed; that is, that the fat content of the milk is increased.

Effect on quality. 1. *Cotton-seed meal vs. no cotton-seed meal.*—A number of cows were fed alternately on rations containing cotton-seed meal and those containing no cotton-seed meal, and samples of the butters produced were sent to four "well-known butter experts" to be graded on the following scale of 100 points: flavor 45, grain or texture 30, and firmness or body 25 points. All of the butters were from mixed milk of four to six cows; and each sample representing a given food or mixture had been churned and worked by itself. The average results of the gradings of each sample are stated in tabular form. The inference is that "flavor seems to suffer a little, and the total grade per cent is thus reduced somewhat, but beyond this, in the opinion of the gentlemen acting as judges, there was little if any observable difference in quality due to the feeding of cotton-seed meal.

"To many who are not familiar with the peculiar effect of cotton seed it may seem that texture [of the butter] is dependent on manipulation

solely, and not on food; but it is well known among handlers of cotton-seed butter that its effect on texture is quite similar to the effect of over-working."

2. *Cotton seed vs. cotton-seed meal.*—With daily rations consisting of 11 pounds of oats together with either 4 pounds of cotton-seed meal or 11 pounds of cotton seed, raw or cooked, the effects seemed to be practically identical. The grading of the butter produced on these rations was, however, about 10 points below that produced where no cotton seed or cotton-seed meal was fed.

3. *Cotton seed alone.*—Where no other food than cotton seed raw or cooked was fed, the quality of the butter produced seemed to be considerably affected, being graded by the judges about 15 points lower than that produced in the trials where other foods were fed. "From the tables relating to the quality of butter it will be seen that the feeding of cotton-seed meal beyond a certain limit injures more or less the quality of butter produced in direct ratio with the quantity fed." The limit with cows on good grass pastures or heavily soiled with green fodders is stated to be about 1 part by weight of cotton-seed meal to either 3 parts of wheat bran, or 2 of bran and 1 of oats; or equal parts of cotton-seed meal, corn meal, and wheat bran. "Where cotton seed is used instead of cotton-seed meal, it is recommended to substitute about three times the weight of cotton seed in place of cotton-seed meal, other proportions remaining the same." Previous experience at the station indicates that the effect of these cotton seed feeds on the butter is more noticeable when they are fed with dried fodders in winter than when fed in larger quantities, with abundant grass, in the spring.

Effect on color of butter.—"Cotton seed or cotton-seed meal has quite a noticeable effect on the color of butter, rendering the product very much lighter." This effect, owing to the difference in coarse fodders fed, is stated to be more marked in winter than in summer. The case is cited of a Jersey cow whose butter, rich in color when no cotton seed was fed, became "almost as white as tallow" after feeding cotton seed exclusively for two weeks, the normal color returning when other rations were substituted for the cotton seed.

Effect on "churnability."—When cotton-seed meal or cotton seed was fed the temperature required for churning was raised, in the case of acid cream from 4 to 8° Fah., and of sweet cream from 1 to 3° Fah., above that required where neither of these substances had been fed. At a temperature of from 60 to 64° Fah. it was impossible to obtain butter from sour cream, although the churning was continued during five hours. Where the cows were fed on cotton seed or cotton-seed meal exclusively, the most advantageous temperature for the churning was found to be 73 to 80° Fah., the average time required at this temperature being thirty-three minutes; when they were fed largely but not entirely on cotton seed or cotton-seed meal the best temperature seemed to be 68 to 75° Fah., and the average time required thirty-

eight minutes. When the cows were fed cotton seed or cotton-seed meal exclusively, the average time required for the churning at 68 to 76° Fah. was, in six cases, one hour and fifty-six minutes, while the average of three churnings at 73 to 80° Fah. was only thirty-three minutes.

QUALITY OF BUTTER FROM SWEET AND SOUR CREAM, G. W. CURTIS, M. S. A. (pp. 15, 16).—In seven trials sweet cream, thoroughly mixed, was divided into two equal weight parts, and one half churned immediately, while the other was allowed to become slightly acid before churning. In each trial nearly like amounts of butter were obtained from the two portions. The samples were graded as above described. The results, which are stated in a table, show scarcely a noticeable difference between the two kinds of butter, the difference, if any, being in favor of the sweet-cream butter, and chiefly in the flavor.

Texas Station, Bulletin No. 12, September, 1890 (pp. 7).

THE SCREW WORM, M. FRANCIS, D. V. M. (pp. 21–25, illustrated).—Notes on the screw worm (*Lucilia macellaria*), supplementary to those published in the annual report of this station for 1888. This insect causes serious injury to domestic animals in Texas, especially to cattle.

They occur in wounds from horns, castrating, spaying, branding, dehorning, barbed wire injuries, and often where ticks have burst on the brisket, flank, or just behind the udder of cows. They often occur in the vulvæ of fresh cows, especially if there has been a retention of the placenta or after-birth. Young calves are almost invariably affected in the navel and often in the mouth, causing the teeth to fall out. One case occurred in the first stomach (paunch or rumen) that is worthy of mention: Last September the writer had occasion to kill a Jersey bull calf, probably two months old, that had screw worms in both hind legs just above the hock joint. On opening the abdomen I found hair balls in the stomach (rumen), and, to my surprise, about twenty-five fully matured screw worms almost buried in the wall of that organ. I placed some of the worms in moist earth, and in ten to twelve days they hatched out genuine screw-worm flies. How did they come there? My opinion is that the calf licked the sores on his legs, and in doing so took in some eggs that hatched and developed in the stomach. * * *

In all animals alike, the eggs, after being laid by the fly, hatch into larvæ or so-called "worms." The exact length of time this requires seems to vary with circumstances. My present opinion is that if the eggs are laid in a moist place and on a warm day, it requires less than one hour; whereas, if laid in a dry place they seem to dry up and lose their vitality. The young larvæ, when first hatched, are small and easily overlooked. If hatched on the surface they attempt to perforate the skin, and if hatched in wounds they at once become buried out of sight. They seem to attach themselves by their heads and burrow their way under the skin, completely devouring the soft flesh. * * * They evidently produce considerable irritation, for the part is always swollen and constantly bleeding. * * * At the end of a week the worms leave the sore and go into the ground, where they pass their pupa state and hatch out as flies in from nine to twelve days. Of several hundred hatched out by the writer, the shortest time was nine days, and the longest fourteen days, but in the majority of cases it required from nine to twelve days. While the larvæ are thus developing the flies are constantly laying fresh eggs in the wounds, so that the young worms take the place of the matured ones, and thus keep up a

constant and progressive loss of tissue. If the worms are not killed they eat constantly deeper, and often kill the animal. * * *

The treatment usually employed in these cases consists simply of killing the larvæ with cresylic ointment, calomel, chloroform, or carbolic acid. The selection of the most suitable remedy will vary somewhat with the location, character, and extent of the sores. In some cases bandages are useful. In others the sores can be filled with oakum and a few stitches taken. All treatment should be supplemented by daubing the margins of the wound with pine tar to ward off the fly. A vast number of cases can be prevented by keeping cattle free from common cattle ticks.

The insect in its various stages is briefly described by C. M. Weed, M. S., of the Ohio Station, and illustrated by photo-engravings from original drawings by Miss Freda Detmers.

West Virginia Station, Bulletin No. 7 (pp. 72).

EXPERIMENTS WITH WHEAT, FRUIT-TREES, VEGETABLES, GRASSES, FORAGE CROPS, ETC., J. A. MYERS, PH. D. (pp. 155–224).—This consists mainly of reports received from farmers in the different senatorial districts of the State on tests of varieties of wheat sent them by the station in the fall of 1888, in accordance with an order of the board of regents of the State University. The individuals to whom seed was sent "were selected by the members of the board of regents as being among the farmers in their districts most likely to carry out the work contemplated." Each farmer received sufficient seed to plant 1 acre, and was requested to report to the station "the manner in which the soil is prepared for the crop; the previous condition of the soil with reference to the crops grown upon it; the condition of the soil at the time of planting, whether in good physical condition or not; the condition of the weather succeeding the time of planting, and success in getting a stand; the onslaught of insects or diseases upon the crop; the ability of the crop to withstand the climate, that is, the percentage that is able to withstand drought or excessive freezing; the peculiarities of the growth of the crop; time of ripening; and the yield per acre secured."

Lists of the varieties of fruit-trees, vegetables, grasses, forage crops etc., sent out to a few individuals, are given, together with a brief report received from one of these persons.

The result of this attempt to distribute the work of experimenting throughout the State under conditions which made it impracticable for the station to exercise any proper supervision of the tests, is thus summed up in this article:

In looking over the reports, we find but one from seven hundred and eight experiments in wheat in which any attempt was made to carry out instructions. We have failed to receive any report from 85 per cent of the experiments and very few of those making reports claim to have any more than approximations. In the most of cases the land and crops were estimated, not measured. It generally happens that there is no unanimity in results reported upon the same varieties, so that our conclusion is that no reliance whatever can be placed upon experimental work intrusted to persons unfamiliar with scientific methods and not provided with facilities for measuring their crops and lands.

It is evident that the attention to details necessary to make an experiment successful can not be bestowed upon it by the average farmer whose time is taken up with questions of more immediate and vital interest to him, and it is hoped that our experience will be of the greatest possible value in this direction, not only to this State, but to the stations located in other States. * * * The attempt has been honestly made and faithfully carried out. It was intended as an answer to what appeared to be a popular demand that experimental work should be widely distributed over the State, and should be intrusted to "practical farmers" rather than to scientific men carefully trained in the methods of experimentation. Our board, after careful consideration of the subject and counsel with the Department of Agriculture, has deemed it wise to discontinue the effort to carry on experimental work of the character reported in this bulletin, and it has determined to abandon it.

Wisconsin Station, Bulletin No. 25, October, 1890 (pp. 10).

FEEDING BONE MEAL AND HARD-WOOD ASHES TO HOGS LIVING ON CORN, W. A. HENRY, B. AGR.—The experiments, which are a continuation of previous experiments on this subject (See Annual Report of the Station for 1889, p. 15) were made to compare the results of feeding corn meal alone and the same with small amounts of either bone meal or wood ashes to pigs. Two separate trials were made. In each, six pigs one hundred and twenty-eight or one hundred and twenty-nine days old at the beginning of the experiment were divided into three lots of two pigs each, one lot in each case receiving corn meal alone, another corn meal and bone meal, and a third corn meal and ashes, all having as much salt as they would eat. In both trials the feeding commenced September 30, 1889, and ended in one case December 23, and in the other January 20, 1890. The animals were slaughtered at the close of the trial, and the thigh bones, after their strength had been tested, were burned to determine the amount of ash they contained. The bulletin contains a partial statement of the results of the two trials and a summary including the results of a previous trial, the details being reserved for the annual report.

Summary of results of three trials in feeding bone meal and hard-wood ashes.

Material fed with the corn meal.	Corn meal eaten per 100 pounds gain in live weight.				Average breaking strength of thigh bone.				Total ash of thigh bones.			
	First trial.	Second trial.	1888–89.	Average.	First trial.	Second trial.	1888–89.	Average.	First trial.	Second trial.	1888–89.	Average.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Bone meal	519	426	518	487	417	806	817	680	109.0	224.5	164.0	165.8
Ashes	543	417	515	491	340	780	625	581	97.0	215.7	188.1	150.2
Nothing	853	466	568	629	306	292	305	301	88.9	144.1	87.6	107.0

From the three trials the author concludes:

(1) That the effect of the bone meal and ashes was to save about 130 pounds of corn, or 28 per cent of the total amount fed in producing 100 pounds of gain, live weight.

(2) That by feeding the bone meal we doubled the strength of the thigh bones; ashes nearly doubled the strength of the bones.

(3) There was about 50 per cent more ash in the bones of the hogs receiving bone meal and hard-wood ashes than in the others.

A careful examination revealed no difference in the proportion of lean to fat meat in the several carcasses. The bone meal and ashes seemed to have no effect on the size or weight of any of the internal organs or the weight of blood. The effect is evident only in the building up and strengthening of the bones and aiding digestion. These experiments point to the great value of hard-wood ashes for hog feeding, and show that they should be regularly fed. Bone meal seems to build up somewhat stronger bones than ashes, but ashes do the work well enough and usually cost nothing with the farmer. Where they can not be obtained bone meal is strongly recommended.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

DIVISION OF BOTANY.

CONTRIBUTIONS FROM THE UNITED STATES NATIONAL HERBARIUM, NO. 3 (pp. 63-90).—This includes a paper by G. Vasey and J. N. Rose, containing a list (with descriptive notes) of plants collected by Dr. Edward Palmer, in 1890, in Lower California and Western Mexico, at La Paz, San Pedro (Martin Island), Raza Island, Santa Rosalia, Santa Agueda, and Guaymas.

DIVISION OF ENTOMOLOGY.

INSECT LIFE, VOL. III, NO. 3, NOVEMBER, 1890 (pp. 89-129).—The principal articles in this number are those on some new iceryas (*Icerya rosæ*, Riley and Howard; *I. ægyptiacum*, Douglas; *I. montserratensis*, Riley and Howard; and *I. palmeri*, Riley and Howard), with illustrations; teaching entomology, by A. J. Cook (the president's address to the Entomological Club of the American Association for the Advancement of Science, at Indianapolis, Indiana, August 20, 1890); army-worm notes, by F. M. Webster; an experience with rose-bugs, by J. B. Smith; note on the period of development in *Mallophaga*, by H. Osborn; the cypress-twig borer (*Argyresthia cupressella*, Wlsm.), by D. W. Coquillett; notes on the genus *Argyresthia*, Hb., with descriptions of new species (*Argyresthia cupressella, A. freyella*, and *A. plicipunctella*), by Lord Walsingham.

DIVISION OF VEGETABLE PATHOLOGY

JOURNAL OF MYCOLOGY, VOL. VI, NO. 2 (pp. 45-87, illustrated).—This number includes the following articles: A new hollyhock disease (*Colletotrichium althææ*, n. s.), by E. A. Southworth; description of a new knapsack sprayer, by B. T. Galloway; recent investigations of smut fungi and smut diseases (continued), by Dr. Oskar Brefeld; preliminary notes on a new and destructive oat disease, by B. T. Galloway and E. A. Southworth; copper soda and copper gypsum as remedies for grape mildew, by J. Nessler (translated by G. McCarthy); note on a Minnesota species of *Isaria* and attendant *Pachybasium*, by C. MacMillan; a few new fungi, by J. B. Ellis and S. M. Tracy; combating the potato blight, by J. H. Bünzli (translated by G. McCarthy); *Mucronoporus andersoni*, n. s., by J. B. Ellis and B. M. Everhart; and index to North American mycological literature (continued), by D. G. Fairchild.

EXPERIMENT STATION NOTES.

ARIZONA STATION.—The governing board as at present organized includes Merrill P. Freeman, *ex officio*, president, Tucson; Selim M. Franklin, Ph. B., Tucson; George W. Cheney, Tombstone; Robert T. Millar, Tucson; F. H. Goodwin, Tucson; J. A. Jones, Globe; W. R. Stone, Florence; Nathan O. Murphy, Phœnix; John M. Ormsby, secretary, Tucson. The station staff is composed of Frank A. Gulley, M. S., director; Charles B. Collingwood, B. S., chemist; Ferdinand Brandt, horticulturist.

CALIFORNIA STATION.—C. H. Shinn has been appointed inspector of stations, vice W. G. Klee. K. McLennan, heretofore foreman at the central station, has been appointed foreman of the South California Station near Pomona. The buildings for the South California Station are nearly completed and planting will soon begin there. In addition to the ordinary vintage work of the central station, a series of nitrogen determinations of grape musts from different localities is in progress. Musts from the same and different varieties will be compared, with a view to finding explanations of the great differences in the keeping qualities of wines. Great local differences have already become apparent.

There is also in progress a series of determinations of the oil content of about twenty different varieties of olives now growing in the State, together with practical tests of oil making therefrom. The oil from the pits and pulp is determined separately, in order to deduce therefrom practical precepts in regard to the methods of oil making, it being well known that the ordinary ("Mission") olive of the Pacific coast rarely contains any kernels in its seeds. Verifications of commercial tests of these oils seem to show very material differences in the standards to be accepted for California oils as compared with Italian and French, especially as regards the iodine test. Egyptian date-palms received from the United States Department of Agriculture are to be tested at the substations at Pomona and Tulare.

CONNECTICUT STATE STATION.—A. W. Ogden, Ph. B., has been appointed one of the chemists of the station, vice R. S. Curtiss, Ph. B. Dr. Roland Thaxter has announced the discovery of an organism, a fungus apparently undescribed, which causes the deep form of "potato scab" so common and destructive in New England, and has produced the disease on sound potatoes by inoculation from pure cultures under test conditions. S. W. Johnson and T. B. Osborne have found that Wagner's modification of Sonnenschein's method for determining phosphoric acid, which has been adopted essentially by the United States Association of Official Agricultural Chemists, while entirely accurate for ordinary phosphates containing but little iron and alumina, gives incorrect and too high results when applied to Thomas slag, Keystone concentrated phosphate, Grand Cayman's rock, and similar aluminous and ferruginous phosphates.

Dr. Osborne has made an extended study of the proteids of the oat kernel. His results, in brief, are as follows: (1) The alcohol-soluble body first observed by Norton has not the composition assigned to it by Kreusler and Ritthausen, but contains 1.3 per cent less nitrogen than given by these authors, agreeing more nearly with Ritthausen's *mucedin* than with his gliadin. (2) When oats are first treated with water or 10 per cent solution of common salt before extraction with alcohol, the alcohol-soluble proteid undergoes alteration, and a body of different composition and

properties results. (3) In the presence of water or of 10 per cent salt solution, the remaining proteids rapidly suffer change and become insoluble in salt solution. (4) The proteid extracted by 10 per cent salt solution behaves towards re-agents like *myosin* from animal muscle, as Weyl first pointed out. Contrary to Weyl's observations, however, the coagulation temperature is much higher than that of animal myosin. This proteid appears to be the result of alteration, similar to that by which myosin is formed from myosinogen. In composition it is almost identical with muscle myosin. (5) The proteid extracted by dilute potash, after complete exhaustion of the oats with 10 per cent salt solution, has the same composition as the proteid extracted by salt solution directly and is apparently the "albuminate" form of that substance. (6) A large share of the proteids of the oat when exposed to the action of water become insoluble in dilute potash solution, the amount so rendered insoluble increasing with the duration of the contact with water. One hour's treatment with water rendered one half, twenty-four hours' treatment made two thirds insoluble in two tenths per cent solution of potash. The composition of the part soluble in potash after removal of the alcohol-soluble proteid is the same as that of the part soluble in salt solution. (7) When ground oats are directly extracted with weak potash solution, without previous treatment with water, nearly the whole of the proteid is dissolved. The substance so extracted, after completely removing the body soluble in alcohol, has a different composition from that similarly obtained after first treating with water. This body is undoubtedly the same as that designated *avenine* by Johnston and Norton. The proteid obtained by extraction with potash, after the action of water, is the substance called by Kreusler *oat-legumin.* (8) When ground oats are extracted with 10 per cent sodium chloride solution heated to 65° C., a proteid separates on cooling in the form of spheroids. This substance differs in composition and properties from that obtained from the cold salt solution, as well as from all proteids hitherto described. It is soluble in pure water, is precipitated from such solutions by a little sodium chloride, is again dissolved by a certain additional quantity, and is precipitated completely by saturation with this salt. In the presence of a little sodium chloride and acetic acid it is soluble in alcohol of 0.9 specific gravity from solutions in distilled water, as well as from those in sodium chloride brine. It has been obtained crystallized in regular octahedrons. (9) The aqueous extract of ground oats was found, in agreement with Norton and Kreusler, to contain very little proteid substance. The proteids thus dissolved appear to be, first, a *globulin*, similar in reactions to that extracted by 10 per cent salt solution; second, a *proteose;* and possibly, third, a little *acid-albumin*. No true albumin was found in the water extract. (10) In the salt extract a very small amount of a body was found having the reactions of albumin.

MASSACHUSETTS HATCH STATION.—An electrograph, consisting of Thomson's quadrant electrometer, with registering and water-dripping apparatus, has recently been purchased for the meteorological observatory. This electrograph is like the one at Greenwich Observatory, England, and is the latest and most improved of Sir William Thomson's instruments. It is most valuable and useful for accurately measuring potentials and for the observation of atmospheric electricity. The oscillations of the needle, showing the electrical potential of the atmosphere, are continually photographed. The cylinder carrying the sensitized photographic paper is turned once in thirty hours by powerful clockwork. Every alternate hour a screen shuts off the pencil of light for four minutes and thus the time spaces are traced upon the chart. The scale readings of the latter are reduced to absolute measurements by multiplying by the constant of the instrument. A barn for use in feeding experiments, tests of seeds, etc., has recently been completed.

OHIO STATION.—The following statement regarding the newspaper bulletins of this station was furnished by Director Thorne, at the request of this Office:

The mailing list of the Ohio Station, though large, does not contain the names of more than one in six of the farmers of the State. It is believed that many farmers

might be reached through the local press who do not read either the station's bulletin or any agricultural journal. It is difficult to secure the co-operation of the local journals, however, as most of them receive their general news either already printed, in the form of "patent insides," or in stereotype plates, and do not care to be at the extra expense of "setting up" any matter not exclusively local. After several futile attempts to secure republication of extracts from the bulletin or notices of its contents, in papers of this class, by sending them the bulletin printed on one side of the paper only so as to be in convenient form for clipping, and by sending brief summaries of its contents, the following plan was adopted:

The Central Press Association of Columbus, Ohio, is a "plate" house, supplying a large number of local papers. This association proposed to print weekly a digest of the station's bulletin or of those of other stations, and to permit the station to reprint from its plates a special newspaper bulletin, to be sent to such journals as are not included in its own subscription list. The only exclusive privilege insisted upon by the association was that the matter under consideration should not be furnished to any other "plate" or "inside" house, and that the Central Press Association should have one week's priority in publication.

Under this arrangement the station sends to the Central Press Association on the first of each week a digest of its own work or that of other stations to the extent of about half an ordinary newspaper column. This is published that week in the weekly journals subscribing to the Central Press Association, and at the end of the week some seven hundred slips are struck off from plates furnished by the Central Press Association and mailed as a special "Newspaper Bulletin" to the newspapers of the State.

Thus far the plan is working satisfactorily. In addition to the large number of journals that use the plates of the Central Press Association, a considerable number republish the matter from the slips sent out—as large a number, we think, as have ever published our work under any other arrangement.

Utah College and Station.—A boarding-house with accommodations for seventy-five students is being erected. Tests of wagons, plows, and cultivators have been made with the dynamometer. Experiments in animal nutrition are planned.

Virginia Station.—H. M. Magruder has been appointed to take charge of the recently established substation, and to supervise experiments carried on outside of the station.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

NOVEMBER 1 TO DECEMBER 1, 1890.

Report of the Secretary of Agriculture for 1890.

Division of Botany:

Contributions from the United States National Herbarium, No. 3, November 1, 1890.—List of Plants Collected by Dr. Edward Palmer in 1890, in Lower California and Western Mexico.

Division of Entomology:

Periodical Bulletin, Vol. III, No. 3, November, 1890.—Insect Life.

Division of Statistics:

Report No. 79 (new series), November, 1890.—Report on Yield of Crops per Acre; Freight Rates of Transportation Companies.

Office of Experiment Stations:

Experiment Station Record, Vol. II, No. 4, November, 1890.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS

NOVEMBER 1 TO DECEMBER 1, 1890.

THE DELAWARE COLLEGE AGRICULTURAL EXPERIMENT STATION.
Bulletin No. 10, October 1890.—Diseases of the Vine.

GEORGIA AGRICULTURAL EXPERIMENT STATION:
Second Annual Report, January, 1890.

IOWA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 11, November, 1890.—Experiments in Making and Storing Hay; Cultivated and Wild Varieties of the Grasses in Iowa; Creamery and Dairy Notes; The Potato-Stalk Weevil; The Apple Curculio; Kerosene Emulsion as a Sheep Dip and as a Destroyer of Parasites upon Domestic Animals; Third Annual Report.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:
Bulletin No. 65, August, 1890.—Planting for Honey.
Bulletin No. 66, September, 1890.—The Plum Curculio.

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 13, September 25, 1890.—Feeding for Milk and Butter.

NEW JERSEY STATE AND COLLEGE AGRICULTURAL EXPERIMENT STATIONS:
Bulletin No. 74, October 21, 1890.—Ground Bones and Miscellaneous Samples.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 21, October, 1890.—Tomatoes.
Bulletin No. 22, November, 1890.—On the Effect of a Grain Ration for Cows at Pasture.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 71, May 15, 1890.—Co-operative Field Tests During 1889; Hillside Ditches.
Bulletin No. 72, June 1, 1890.—The Work of the Horticultural Division; The Value of Pea-Vine Manuring for Wheat.
Bulletin No. 72c (Meteorological Division Nos. 10 and 11).—Meteorological Summary for North Carolina, July, 1890, and August, 1890.

OHIO AGRICULTURAL EXPERIMENT STATION:
Bulletin Vol. III, No. 7 (second series), August, 1890.—Strawberries; Raspberries.

OREGON EXPERIMENT STATION:
Bulletin No. 6, July, 1890.—Examination of Cattle Foods; General Information.

THE PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 12, July, 1890.—Simple Methods of Determining Milk Fat.

RHODE ISLAND STATE AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 6, March, 1890.—Milk Fever or Parturient Apoplexy in Cows.
Bulletin No. 7, June, 1890—Catalogue of Fruits; Meteorological Summary; Spring Report of the Apiarist.

Tennessee Agricultural Experiment Station:
Special Bulletin D, July 10, 1890.—Potash and Paying Crops.

Agricultural Experiment Station of Utah:
Bulletin No. 2, November, 1890.—Plow Trials.

Vermont State Agricultural Experiment Station:
Bulletin No. 21, September, 1890.—A New Milk Test; Testing Milk at Creameries and Cheese Factories; Notes for the Laboratory.

DOMINION OF CANADA.

Bureau of Industries, Toronto, Ontario:
Bulletin No. 35, November 10, 1890.—Statistics of Crops in Ontario.

EXPERIMENT STATION RECORD.

Vol. 2. FEBRUARY, 1891. No. 7.

EDITORIAL NOTES.

Agricultural experiment stations are now in operation under the act of Congress approved March 2, 1887, in all the States and Territories except Montana, Washington. Idaho, Wyoming, and Oklahoma. In several States the United States grant is divided, so that 46 stations in 43 States and Territories are receiving money from the United States Treasury. In each of the States of Connecticut, Massachusetts, New Jersey, and New York a separate station is maintained, entirely or in part, by State funds, and in Louisiana a station for sugar experiments is maintained mainly by funds contributed by sugar planters. In several States branch or substations have been established. If these be excluded the number of stations in the United States is 52. During the past year 6 new stations have been established, viz., in Northern and Southeastern Alabama, Arizona, New Mexico, North Dakota, and Utah. The stations, with this Office, received in all during 1890 about $915,000, of which $660,000 was appropriated from the National Treasury, the rest coming from State governments, private individuals, fees for analyses of fertilizers, sales of farm products, and other sources. The stations employ 428 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work is as follows: directors, 66; chemists, 101; agriculturists, 63; horticulturists, 47; botanists, 42; entomologists, 33; veterinarians, 19; meteorologists, 11; biologists, 4; viticulturists, 2; physicists, 3; geologist, 1; mycologists, 2; microscopists, 4; irrigation engineer, 1; in charge of substations, 16; secretaries and treasurers, 21; librarians, 5; clerks, 17. There are also 42 station officers not included in the foregoing classification. These are superintendents of gardens, grounds, and buildings, foremen of farms and gardens, dairymen, apiarists, herdsmen, engineers, laboratory assistants, etc.

During 1890 the stations published 36 annual reports and 225 bulletins. The mailing list of the stations now aggregates about 340,000 names. At a low estimate a total of thirty-five millions of pages con-

taining information on agricultural topics, have been disseminated among the people by the stations during the past year. The results and processes of experiments are also described in thousands of newspapers and other periodicals. The mailing lists of the stations have largely increased during the year. The calls upon station officers to make public addresses are numerous and increasing. The number of such addresses reported to this Office as delivered during the past year is about 750. The station correspondence with farmers is now very large and touches nearly every topic connected with farm theory and practice. A number of stations have made exhibits of the processes or results of their investigations at State and county fairs. There have been many evidences of public approval of the stations and their work as indicated by acts of the State legislatures in their behalf and gifts of money by local communities, agricultural associations, and private individuals, and by commendations of their work in the agricultural journals, as well as by farmers. The relatively large space given to reports of the work of the stations in the agricultural press is also an indication of the increasing favor in which the stations are held.

The following statements regarding the institutions in which investigations in agricultural science are being carried on in Japan have been taken from a communication of Professor O. Kellner to this Office:

(1) *Imperial College of Agriculture, Tokio.*—This institution was founded in 1876 and was at first under the control of the Department of the Interior, but was afterwards transferred to the Department of Agriculture and Commerce. In June, 1890, it was made a part of the Imperial University and thus came into the charge of the Department of Public Instruction. The college is divided into the faculties of agriculture, forestry, and animal industry, and possesses laboratories for original researches in general chemistry, agricultural chemistry, physics, zoölogy and entomology, botany, histology, and bacteriology, together with 50 hectares of farming land. The directors of these laboratories are all engaged in original research. The agricultural-chemical laboratory was for several years under the management of Edward Kinch, now a professor at Cirencester, England. Since 1881 Professor O. Kellner has been director of the laboratory, where three assistants are now employed. The director is also a consulting agricultural chemist for Japan. At present the laboratory is chiefly used for governmental purposes, but also affords opportunities for instruction. Each year three or four students who have already received considerable training in general chemistry and quantitative analysis are admitted here. After three years' instruction in analytical work and in agricultural experiments, the best of these students are employed as assistants and teachers in the agricultural colleges and schools.

Mr. Kinch published A Classified and Descriptive Catalogue of Agricultural Products Exhibited at Sydney, Australia (Tokio, 1879). This contains numerous analyses of Japanese soils, manuring materials, and technical products. Professor Kellner has published some twenty-three accounts of original investigations in the *Landwirthschaftliche Versuchs-Stationen* (Bde. 30, 32, 33, 37), *Landwirthschaftliche Jahrbücher* (Bd. 15), *Zeitschrift für Physiologische Chemie* (Bd. 14), *Zeitschrift für Biologie* (Bd. 10), and *Mittheilungen der deutschen Gesellschaft für Natur- und Völkerkunde Ostasiens* (Bd. 4). These include reports of inquiries on the physics and chemistry of soils, composition of crops, use of fecal matters as manure, the growth and nutrition of silk-worms, silage, digestion experiments with sheep, nitrogen compounds in atmospheric precipitation, the effects of ferrous compounds on vegetation, composition of tea leaves and methods of drying the tea, the liberation of free nitrogen by putrefaction and nitrification, the food of the Japanese, invertive ferments, rice cultivation, and the composition and digestibility of rice straw. The Imperial College of Agriculture and Dendrology at Tokio has also published seven bulletins in English, of which five are by Professor Kellner, one by Professor Georgeson, and one by Mr. Kozai. The titles of these bulletins were given in Experiment Station Record, Vol. 1, p. 247.

(2) *Agronomical section of the Imperial Geological Survey of Japan, Tokio.*—The Imperial Geological Institute was established in 1879, and comprises five divisions, viz., geological, agronomical, technical-chemical, topographical, and executive. The development of this institution is described in a work by the ministerial councilor, T. Wada, entitled *Die Kaiserliche Geologische Reichsanstalt von Japan, zusammengestellt für den Internationalen Geologen Congress zu Berlin, 1885* (Berlin, R. Friedländer u. Sohn, 1885). The agronomical division was for a brief period in 1880 under the direction of Dr. G. Liebscher, now professor at Göttingen, and from 1882 has been in charge of Dr. M. Fesca, who is also a professor in agriculture at the Imperial College of Agriculture at Tokio. The number of assistants has been increased until now ten are employed. A laboratory for soil analyses forms a part of the equipment of this section. During the summer the force is chiefly engaged in surveys and investigations in the country, and during the winter in analyzing the specimens of soils collected, in preparing soil charts, and in working up and reporting results. These workers are also expected to study the agricultural needs of the districts in which their surveys are made and to give useful information to farmers, thus acting as itinerant teachers of practical agriculture, a work of especial importance in view of the present condition of affairs in Japan. Thus far agronomical charts for seven provinces have been published and thirteen other maps are in course of preparation. These charts are lettered in English and Japanese, and are accompanied by explanatory statements in Japanese.

Articles on the following subjects have been published by Professor Fesca: On the method of determining the various degrees of the oxydization of iron in cultivated soils (*Journal für Landwirthschaft*, Bd. 32); discussion and explanations of the agricultural maps (Imperial Geological Institute, Tokio, 1887); on the agricultural resources of Japan and the colonization of Hokkaido (Yezo), (Imperial Department of Foreign Affairs, Tokio, 1887); on the cultivation, treatment, and composition of tobacco (*Landwirtschaftliche Jahrbücher*, 1888); contributions to a knowledge of Japanese agriculture, with an atlas of twenty-three charts (Berlin, P. Parey, 1890). Of this last only the atlas and one part of the text have yet been issued. The publications of this institute, as far as they can not be obtained of German book dealers, will be supplied to interested parties by the director of the Imperial Geological Survey (T. Wada, Tokio, Tchigaya, 36).

(3) *The Laboratory of the Fish Commission, Imperial Department of Agriculture, Tokio.*—This has been in existence for ten years and is devoted to investigations and experiments on fish culture and utilization of the products of salt and fresh waters. The bureau sustains fishery stations in various parts of the country. Its reports have thus far been issued only in the Japanese language.

(4) *Imperial College of Agriculture at Sapporo, Yezo.*—This institution was founded in Japan in 1876 by the Imperial Colonization Bureau for the Yezo Island. In the first annual report (1876–77) the scope of its work was thus defined: "The education and practical training of young men from all parts of the Empire, who are expected to become employés of the colonial department after graduation and to remain in its service for the term of five years." The number of students is limited and all their expenses while in the college are defrayed by the Government. The course of instruction covers 4 years and leads to the degree of Bachelor of Science.

The following gentlemen from the United States have been connected with this institution at different times: William S. Clark, Ph. D., LL. D.; William Wheeler, B. S.; D. B. Penhallow, B. S.; W. P. Brooks, B. S.; S. C. Cutter, M. D.; Selim H. Peabody, LL. D.; and H. E. Stockbridge, Ph. D. Reports of original investigations conducted at the college by these gentlemen are published in its annual reports.

(5) Besides the two colleges already mentioned, there are in the Empire some ten agricultural schools of lower grade, some of which have experimental grounds and small chemical laboratories in which agricultural investigations are carried on.

(6) In the southern part of Japan (Kiushiu Island) experiments have been made for about three years on tropical and subtropical plants.

(7) The interests of agriculturists, as well as of navigators and the general public, are also served by an Imperial Central Meteorological Observatory, with which are connected forty-one meteorological stations distributed throughout Japan.

Since the above was written a letter has been received at this Office from Tokio, Japan, stating that a considerable number of influential men in Japan have presented a petition to the newly established Parliament in behalf of the organization of agricultural experiment stations, and asking for copies of Farmers' Bulletin No. 1 of this Office entitled The What and Why of Agricultural Experiment Stations, to be given to members of the Parliament who are familiar with English and translated into Japanese for those who are not. This is another of the many indications of the appreciation with which the experiment station enterprise is being received throughout the civilized world.

In order that the Experiment Station Record may make a more complete showing of the work of the stations in the United States, the systematic publication of brief abstracts of their annual reports, as well as of their bulletins, is begun in the present number. Abstracts of the reports for 1889 will be included in the present volume of the Record, and the reports for 1890 will be taken up as they are received by this Office. These reports are often late in publication, from delays in State printing or other causes. Some of those for 1889 have not yet come to this Office. It is intended to give in the next number of the Record brief accounts of current European work in certain lines of agricultural science and to make this a regular feature of the Record as far as the means at the disposal of the Office will allow.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

Alabama College Station, Second Annual Report, 1889 (pp. 24).

This includes the text of the act of Congress of March 2, 1887, under which the station is organized; the plan for the organization of the station adopted by the board of trustees of the college in February, 1888; the resolutions of the State legislature in which assent is given to the act of Congress of March 2, 1887; and reports of the treasurer, director, chemist, botanist and meteorologist, and biologist. These reports contain brief outlines of the work recorded in bulletins of the station, abstracts of which have already appeared in the Experiment Station Record.

Alabama College Station, Bulletin No. 20 (New Series), November, 1890 (pp. 18).

SMALL FRUITS, MELONS, AND VEGETABLES, J. S. NEWMAN AND J. CLAYTON (pp. 3–14).—Tabulated notes on 39 varieties of strawberries grown in 1889, 23 of raspberries, 31 of cantaloupes grown in 1889 and 15 grown in 1890, 24 of water-melons grown in 1889 and 6 grown in 1890, 37 of beans grown in 1890, 17 of tomatoes grown in 1890, and 16 of onions grown in 1890. *Strawberries.*—"Early Canada and Parry are still the earliest varieties tested, and both have improved in quality and productiveness since their introduction to these grounds five years since; of the newer kinds Belmont, Bubach, Haverland, Gandy, Hoffman, and 1001 or 'Eureka' are very promising. The Henderson still leads the list in its quality and its vines are becoming more vigorous and prolific as it becomes acclimated. Wilson, Agriculturist, and Sharpless still hold their places as standards." *Raspberries.*—"Out of more than thirty varieties tested during the last five years Turner is the most hardy and reliable." *Cantaloupes.*—The varieties with deep-green flesh rank higher in this climate than those with yellow flesh. *Water-melons.*—Attention is called to the fact that old varieties are being disseminated under new names. For example, the old and reliable Sugar Loaf has been advertised as Jordan's Gray Monarch or Seminole, and Kolb Gem as New Round Excelsior. "For shipping no other variety

compares with Kolb Gem." For home use Cuba, Sugar Loaf, Florida Favorite, and Pride of Georgia are of fine flavor and tender flesh.

REPORT OF ALABAMA WEATHER SERVICE, P. H. MELL, PH. D. (pp. 15–18).—Brief notes on the weather during October, 1890, and a monthly summary of meteorological data and of observations of soil temperatures.

Alabama Canebrake Station, Second Annual Report, 1889 (pp. 7).

This contains the reports of the treasurer and director. The latter includes a brief outline of the work recorded in bulletins of the station, abstracts of which have already appeared in the Experiment Station Record. Under the head of permanent improvements it is stated that, "since the last report was made a large two-story barn and cow house has been built, and experiments in cattle feeding and pig feeding are now in progress. The lower floor contains eight stalls for cattle, two for pigs, an office, and feed and weighing room. The upper story contains separate compartments for different varieties of hay, while above this is a loft for storage of miscellaneous forage. Fresh water is supplied by a hydrant on the first floor."

Arkansas Station, Second Annual Report, 1889 (pp. 204).

REPORT OF CHEMISTS, C. B. COLLINGWOOD, B. S., AND G. A. HUMPHREYS (pp. 5, 6).—It is stated that in 1889, four hundred and fifty-nine quantitative analyses were made, including "water, cotton seed hulls, shells, silage, strawberries, land plaster, butter, wine, oats, fertilizers, milk, and sorghum." The results of analyses of shells from Ouachita County, a smut destroyer, silage from corn and pea vines, and wines are reported in tabular form.

FERTILIZERS, C. B. COLLINGWOOD, B. S. (pp. 7–18).—This contains general statements regarding commercial fertilizers; the sources and cost of nitrogen, phosphoric acid, and potash; directions for sampling fertilizers; the text of the State law regulating sale of fertilizers, approved March 8, 1889; and analyses of 26 brands of fertilizers, 17 of which were published in Bulletin No. 10 of the station (See Experiment Station Record, Vol. I, p. 9).

CEREALS, A. E. MENKE, D. SC. (pp. 19–26).—A report on experiments with wheat, oats, and corn.

Wheat.—The yields of 10 varieties tested in 1888 and 1889 are given, together with the dates of heading and harvesting and yields of straw and wheat for 12 varieties tested in 1889. There are also brief descriptive notes on 11 varieties and tabulated data for an experiment with fertilizers on wheat. As the result of two years' observations Fultz and Michigan Amber are recommended as varieties suited to the northwestern section of the State. Two years' experiments with fertilizers on

wheat have led the station to recommend 250 pounds of cotton-seed meal to the acre as on the whole the most economical fertilizer for this section. A briefer account of the experiments with wheat was given in Bulletin No. 11 of the station (see Experiment Station Record, Vol. I, p. 188).

Oats.—A tabulated record of experiments in 1889 with fertilizers on oats. A briefer account was published in Bulletin No. 11 of the station (See Experiment Station Record, Vol. I, p. 189).

Corn.—Brief descriptive notes on 10 varieties and tabulated results of tests with 23 varieties at Fayetteville and 24 varieties at Pine Bluff in 1889 are given. There is also a tabulated report for the first year of an experiment with different fertilizers on corn.

POTATOES, A. E. MENKE, D. SC. (pp. 27–39).—The growing of potatoes is becoming of more importance in portions of this State, due to increased shipments to Texas. The station has made tests of varieties and of methods of planting. The latter are regarded at present as only tentative and are not reported in detail in this article. The so-called Carman method of planting has been tried with fairly good results, the yield from this method averaging 33 per cent higher than that from common methods. The dates of planting and blooming and the yield in bushels per acre are stated in tables for 233 varieties; tabulated data are also given for 44 varieties planted in different ways. In a test of the keeping qualities of 25 varieties the percentage of potatoes rotten March 19, 1889, after having been kept during the winter, varied from 5 to 90 per cent.

GRASSES, A. E. MENKE, D. SC., AND R. L. BENNETT, B. S. (pp. 40–45).—"In order to test what grasses will grow on worn cotton lands, we have sown some thirty acres with different varieties of grasses and clovers alone and in various mixtures, fertilized and unfertilized. * * * The land on which they were sown was a sandy soil that is said to have been in cultivation in cotton for thirty-five years. It is a typical soil and well suited to the test contemplated. Plats, one half acre each." Tabulated data are given for 33 of these varieties and for 7 varieties to which various fertilizers have been applied. There are also brief descriptive notes on 23 varieties.

COTTON, A. F. CORY, B. S., AND A. E. MENKE, D. SC. (pp. 46–57).—This is a report of experiments at the branch station at Pine Bluff, conducted on land which had been almost continuously planted with cotton for thirty years, during which time it had probably not received any manure. "At present 900 pounds of seed cotton to the acre is regarded as a good yield under favorable circumstances." The experiments were with cotton-seed meal, acid phosphate, and kainit, singly and in combination, with stable manure in different amounts, and with different composts. Details are stated in tables. The results give the following indications regarding the effects of the fertilizers used, as observed in these experimets:

Nitrogenous manures can be used with profit on our worn lands at Pine Bluff.

One of the effects of nitrogenous manure is to hasten maturity.

Neither acid phosphate nor kainit can be used with profit here.

All of the different plats on which cotton-seed meal was used, either alone or in combination, gave some profit, and this profit seemed due not to the acid phosphate and kainit, but to the cotton-seed meal.

There is no better fertilizer than stable and barn-yard manure.

There are also brief notes on a test of 8 varieties of cotton and an account of the system of shallow, level cultivation adopted at the station, with a statement of its advantages. Some of the sources of error in field experiments are pointed out.

SORGHUM, A. E. MENKE, D. SC., AND C. B. COLLINGWOOD, B. S. (pp. 58–67).—A report of progress on a series of experiments made with a view to finding varieties rich in sucrose which are adapted to the climate of Arkansas and then by cross-fertilization and selection to increasing their sugar content. Tabulated data are given for 34 varieties, including the percentage of sucrose and glucose. Cotton-seed meal, acid phosphate, and kainit, singly and in various combinations, dried blood, and barn-yard manure were applied to Early Orange sorghum on thirty-nine fortieth-acre plats, two other plats being unfertilized. The results of analyses of the crop are stated in tables, together with those for a volunteer crop of Early Amber, which appeared on thirty of the same plats.

SILAGE, A. E. MENKE, D. SC. (pp. 68–77, illustrated).—Silo building and ensiling have occupied the attention of the station for two years, good silage being made in both seasons from corn, sorghum, and pea vines at Pine Bluff and Fayetteville. Practical advice regarding the location, size, and construction of silos; filling and opening the silo; the growing of corn for silage; and the feeding of silage are given in this article. There is also a letter from J. W. Sanborn in which the advantages and disadvantages of silage are discussed.

COTTON-SEED HULLS AS A FEEDING STUFF, A. E. MENKE, D. SC. (pp. 78–82).—This contains an abstract from Bulletin No. 9 of the station (See Experiment Station Record, Vol. I, p. 9) with reference to the method of feeding cotton-seed meal and hulls to cattle, as practiced at the cotton-seed-oil mills, and brief tabulated data on an experiment in feeding calves on the hulls and meal.

REPORT OF HORTICULTURAL DEPARTMENT, E. S. RICHMAN, B. S., AND A. F. CORY, B. S. (pp. 82–104, illustrated).

Strawberries.—This is, in the main, a reprint of the report on strawberries contained in Bulletin No. 11 of this station (See Experiment Station Record, Vol. I, p. 188).

Sweet-potatoes.—Brief notes on experiments with various fertilizers.

Germination tests.—Tabulated notes on germination tests of 34 varieties of radishes and 43 of cabbages, made under shelter in boxes filled with earth and between layers of moist cloth; 38 of tomatoes, made under cloth; 32 of peas and 21 of beans made out of doors.

Experiments with vegetables.—These experiments were conducted at Pine Bluff and included tests of 32 varieties of peas, 17 of beans, 24 of tomatoes, 28 of radishes, 12 of cauliflower, 5 of celery, and 3 of squashes. Tabulated notes are given for most of the varieties tested.

REPORT OF VETERINARIAN, R. R. DINWIDDIE, M. D., V. S. (pp. 105–140).—This includes notes on the following diseases of animals, which occurred in this State during 1888: "glanders, suppurative fever, and 'charbon' in horses and mules; actinomycosis, pasture poisoning, murrain, Texas fever, and liver rot in cattle; and intestinal parasitism in sheep." Special reference is made to observations on cattle attacked by Texas fever.

Spaying of cattle.—General statements on the advantages of this operation, with references to experiments by the station, including those reported in Bulletin No. 8 of the station (See Experiment Station Record, Vol. I, p. 8).

REPORT OF ENTOMOLOGIST, C. W. WOODWORTH, M. S. (pp. 141–196, illustrated).—This includes brief notes on the following insects which injured crops in Arkansas in 1889: Cut-worms, tarnished plant bug, chinch-bug, Hessian fly, striped cucumber beetle, grape leaf folder, grape-leaf hopper, grain plant-louse, peach-tree borer, bag worm, cotton worm, boll-worm, and codling moth; longer accounts of the tarnished plant bug (*Lygus lineolaris*), chinch-bug (*Blissus leucopterus*), and cotton worm (*Aletia xylina*), with suggestions regarding the means for their repression; a brief statement of the differences between the cotton worm and the boll-worm; directions for making moth traps; brief notes on pear blight, sorghum blight, grape mildew, and black rot of the grape; and a short account of experiments in the dry application of a mixture of Paris green and flour for the cotton worm.

Arkansas Station, Bulletin No. 15, December, 1890 (pp. 10).

NEW INSECTICIDES FOR THE COTTON WORM, A. E. MENKE, D. SC., AND G. C. DAVIS.—An account of experiments made by Mr. Davis, as special agent for the station, with insecticides prepared by Director Menke. The aim was to find an effective remedy for the cotton worm, which could be generally used, and which would not be as dangerous to handle as the arsenites are. Kerosene soap, commonly known as "sludge," proved a failure. An emulsion of kerosene with pyrethrum ($1\frac{1}{2}$ gallons to $2\frac{1}{2}$ pounds) was quite effective. "Quite a number of experiments were made to ascertain the best proportions to use in making the emulsion, and it was found to be 1 pound of soap dissolved in 1 gallon of boiling water, and to this boiling hot mixture add 1 gallon of the kerosene extract and mix with a force-pump so thoroughly that the oil will not separate on standing. This will require from 10 to 30 minutes' steady work, according to the quantity and the force used. On cooling, the emulsion will be a thick creamy mass, which can be diluted

with water to the desired proportions." In the proportion of 1 part of the emulsion to 450 or 500 parts of water the mixture was found to be sufficiently strong to destroy the worms. "The extract kills entirely by contact. It makes the cotton worms uneasy as soon as applied and causes them to drop to the ground writhing in great agony. This continues until they become greatly exhausted, when they often remain motionless for some time before death. While the emulsion is so destructive to insect life, it is not in the least injurious to those handling it." As used at the station 1 gallon of the extract cost 65 cents and 1 pound of soap 10 cents. When this is diluted with 450 gallons of water it gives a sufficient quantity of the mixture to spray 15 acres of cotton at a cost of about 5 cents per acre.

Several experiments in which the kerosene extract was combined with wood or coal ashes, cotton-seed meal, or flour, and applied in a dry form, are briefly reported. The most satisfactory results were obtained when the mixture was combined in the proportion of five eighths of a pint of the extract to 1 pound of wood ashes, but the author is not yet prepared to recommend the use of this insecticide in a dry form.

Dry mixtures were also prepared by combining 1 pound of flour with the following quantities of each of the several substances named: santonin (1 ounce), oxalic acid (8 ounces), benzoic acid (1 ounce), mercuric chloride (2 ounces), tartar emetic (1 ounce), salicylic acid (1 ounce), cinchonin (1 ounce), bichromate of potash (8 ounces), hellebore (amount not stated), lead acetate (8 ounces), and veratrin (¼ ounce). The veratrin was by far the most satisfactory in its action. It killed the insects by contact and when they ate it. This insecticide is about as expensive as Paris green.

Observations in the field indicated that the numbers of the cotton worm were diminished by the following enemies: Blackbirds, ants, spined soldier bug (*Podisus spinosus*), dusky plant bug (*Deræocoris rapidus*), a species of *Panorpa*, *Trichogramma pretiosa*, *Chalcis oratus*, and *Euplectrus comstockii*.

Colorado Station, Bulletin No. 12, July, 1890 (pp. 151).

SOME COLORADO GRASSES, AND THEIR CHEMICAL ANALYSIS, J. CASSIDY, B. S., AND D. O'BRINE, D. SC. (illustrated).—In a brief introduction the director of the station states that "this bulletin is the result of work undertaken early in 1889 by the experiment station, to study the grasses of the arid region, and more particularly of Colorado, in order to find, if possible, some varieties which would furnish more and better forage than those now cultivated. The chemical work was undertaken to show the comparison in composition of these species as grown in their native habitat and afterward under cultivation; first, without irrigation, and second, under irrigation. The botanical work has been almost exclusively performed by our late Professor James Cassidy, and the chemical work by Dr. David O'Brine, chemist."

A general classification of the grasses and the characteristics by which they may be distinguished from other plants are given.

The plains grasses are of a dwarf, spreading habit, and present a magnificent sight in June, clothed in the richest green. These grasses are cured during late summer, the result of a high temperature and the absence of rain dissipating the stems and leaves of their surplus moisture. The absence of wet snows, the high day temperature, and the protection afforded by the hills renders the wintering of stock a safe problem.

In order to collect some information in regard to the distribution of particular kinds, their behavior under irrigation in the native meadow, and to collect seeds in quantity of such as were deemed of possible value in the plains region, an expedition was undertaken by the writer, at the instigation of the United States Department of Agriculture and of the State Experiment Station, accompanied by Mr. Holmes, agent of the Department, and by Mr. Hoag, of Fort Collins, who has given considerable attention to the native grasses. The route traversed was a northerly one, through the Virginia Dale country to the Laramie Plains. The irrigated and non-irrigated meadows were carefully examined. Thence by Fort Halleck to North Park, by Pass Plains and Big Creek, to Middle and Ægeria Parks, by the Arapahoe, Muddy and Gore Passes. * * * Seeds were collected of 120 species, but in quantity only of kinds thought to be profitable. The most promising grasses for pasture are *Festuca scabrella, Oryzopsis cuspidata, Elymus sibericus, Agropyrum divergens*, and *Stipa viridula*. For hay: *Agropyrum glaucum* and *violaceum, Poa tenuifolia, Sporobolus depauperatus, Elymus Americanus, Deyeuxia stricta, D. canadensis, Hilaria jamesii.*

While many of the native species are very deficient in top, still it must be acknowledged that they improve wonderfully in vigor with irrigation. This is notably so in the case of buffalo grass (*Buchloë dactyloides*), which more than holds its own in meadows where alfalfa has been thinly seeded and which are irrigated two or three times a year. Some of the grasses collected must prove valuable in regions having a sufficient rain-fall, or where irrigation can be had. Nothing can be finer, in the way of a hay grass, than the glaucous-leaved form of *Poa tenuifolia*, or the two forms of *Agropyrum violaceum*. Of the species most likely to succeed on the dry plains, the following are the most promising: *Elymus sibericus, Agropyrum divergens* in two forms, *Hilaria jamesii, Festuca scabrella, Oryzopsis cuspidata, Kœleria cristata, Sporobolus airoides, Muhlenbergia wrightii, M. gracilis, Bouteloua oligostachya* and *B. racemosa*, and a few others.

Faithful experiment is needed to determine the agricultural value of all species collected, both with irrigation and on the dry plains, where the plants will be sustained by the limited rain-fall alone.

Brief descriptive notes are given on 122 species of grasses, 3 of sedges and rushes, 2 of lupines, and 1 of clover, together with the chemical analyses of 61 species. Chemical analyses of 28 other species of forage plants are also reported. There are also descriptive notes on 5 species of grasses, prepared by C. S. Crandall, M. S., botanist and horticulturist of the station since January, 1890. The bulletin is illustrated with twenty-nine cuts (reprinted from the Special Bulletin of the Botanical Division of the United States Department of Agriculture, entitled The Agricultural Grasses and Forage Plants of the United States), showing as many species.

The species described in the body of the bulletin are *Poa lævis, P. alpina, P. compressa, P. cæsia, P. andina, P. cæsia* var. *stricta, P. alsodes, P. pratensis, P. laxa, P. flexuosa* var. *occidentalis, P. serotina, P. sp ?, P.*

sylvestris, P. eatoni, P. arctica, P. tenuifolia, Panicum dichotomum, P. virgatum var. *glaucophyllum, P. virgatum, P. capillare, P. capillare* var. *minimum, P. glabrum, P. crus galli* var. *echinatum, P. sanguinale, Festuca microstachys, F. tenella, F. ovina* var. *brevifolia, F. kingii, F. elatior, Agrostis alba, A. exarata, A. scabra, A. canina, Lolium perenne, Deyeuxia sylvatica, D. lapponica, D. stricta, D. canadensis, Bromus ciliatus, B. breviaristatus, B. unioloides, B. mexicana, B. kalmii* var. *porteri, B. secalinus, Elymus condensatus, E. sibericus, E. americanus, E. canadensis, E. sp.?, E. sitanion, Catabrosa aquatica, Agropyrum violaceum, A. unilaterale, A. tenerum, A. divergens, A. strigosum, Stipa viridu a, S. spartea, S. mongolica, S. comata, S. sp.?, Deschampsia flexuosa, D. danthonioides, D. cæspitosa, Sporobolus depauperatus, S. asperifolius, S. airoides, S. cuspidatus, S. cryptandrus, Eragrostis purshii, E. poæides, E. poæoides* and var. *megastachya, Muhlenbergia glomerata, M. wrightii, M. gracilis, M. gracilis* var. *breviaristata, M. gracillima, Trisetum subspicatum, Danthonia intermedia, D. californica, Phalaris arundinacea, P. canariensis, Paspalum glabrum, Alopecurus aristulatus, Oryzopsis cuspidata, Alopecurus alpinus, Melica spectabilis, Graphephorum wolfii, Andropogon furcatus, A. scoparius, Ammophila longifolia, Polypogon monspeliensis, Glyceria nervata, G. pauciflora, G. aquatica, G. distans, Setaria viridis, S. glauca, S. italica, Leersia oryzoides, Distichlis maritima, Hierochloa borealis, Eatonia obtusata, Lolium perenne* var. *italicum, Diplachne fascicularis, Kœleria cristata, Spartina cynosuroides, Phleum pratense, P. alpinum, Hilaria jamesii, Cinna arundinacea* var. *pendula, Aristida basiramea, Cenchrus tribuloides, Phragmites communis, Hordeum jubatum, Bouteloua racemosa, B. hirsuta, Beckmannia erucæformis, Schendonnardus texanus, Trifolium eriocephalum, Juncus balticus, J. mertensianus, J. bufonius, Monroa squarrosa, Carex rupestris, Luzula spadicea* var. *subcongesta, Eurotia lanata, Lupinus argenteus, L. argenteus* var. *argophyllus.*

The species described in the appendix are *Bouteloua oligostachya, Buchloë dactyloides, Muhlenbergia glomerata, Festuca scabrella, Agropyrum glaucum.*

Delaware Station, Second Annual Report, 1889 (pp. 195).

REPORT OF DIRECTOR, A. T. NEALE, PH. D. (pp. 7–36).—Brief statements are made regarding the objects and duties of the station; its organization and control, equipments, and management; and the plan and results of its work in 1889. The experimental inquiries undertaken by the station include experiments and observations on the black rot of grapes and other plant diseases, with especial reference to the use of fungicides; experiments in the rotation of crops and in the introduction of alfalfa, sand lucern, esparsette, spurry, and vetches; soil tests with fertilizers; the planting of a garden for tests of varieties of grasses and forage plants; the analysis of feeding stuffs; methods of butter making; work in entomology, horticulture, and meteorology; seed testing; chemical analysis of grapes and other food with refer-

ence to the amount of copper they contained; and experiments with sorghum to test the possibility of developing a domestic sugar industry. The part of the report which treats of sorghum was reprinted in Bulletin No. 8, pp. 3–11, of the station (See Experiment Station Record, Vol. II, p. 46).

REPORT OF BOTANIST, F. D. CHESTER, M. S. (pp. 37–100).—This includes articles on the following subjects: (1) seed testing, (2) a botanical description of the black rot of the grape, (3) the black rot of the grape controlled by the Bordeaux mixture, (4) spraying with sulphide of potassium for the scab of the pear, (5) peach yellows, culture tests, (6) diseases of alfalfa, (7) grass garden.

Seed testing (pp. 37–68).—A reprint of an article in Bulletin No. 5, pp. 5–32, of the station (See Experiment Station Record, Vol. I, p. 23).

A botanical description of the black rot of the grape (pp. 69–78, illustrated).—A reprint of an article in Bulletin No. 6, pp. 18–28, of this station (See Experiment Station Record, Vol. I, p. 196).

The black rot of the grape controlled by the Bordeaux mixture (pp. 79–87).—A reprint of an article in Bulletin No. 6, pp. 7–17, of this station (See Experiment Station Record, Vol. I, p. 196).

Spraying with sulphide of potassium for the scab of the pear (pp. 88–91).—A reprint of an article in Bulletin No. 8, pp. 11–14, of this station (See Experiment Station Record, Vol. II, p. 49).

Peach yell nvs, culture tests (pp. 92–94).—Brief account of experiments in which cultures of the diseased wood of peach trees were made in infusions of healthy peach wood and in nutrient gelatine. No signs of becterial growth were discovered in these tests.

Diseases of alfalfa (pp. 94–97).—Notes on observations of *Phacidium medicaginis*, Larsch., and *Cerospora helvola*, Sacc., var. *medicaginis*, which were found on alfalfa plants in Delaware in 1889.

Grass garden (pp. 98–100).—A list of 45 species of grasses and forage plants planted at the station in 1889, with especial mention of 14 varieties which made good growth and promised well.

REPORT OF HORTICULTURIST AND ENTOMOLOGIST, M. H. BECKWITH, M. S. (pp. 101–136).—This includes articles under the following titles: (1) plan of work, (2) small-fruit plats, (3) notes on black rot of grapes, (4) insects injurious to crops in Delaware, (5) their identification and extermination, (6) answers to inquiries, (7) experiments with insecticides.

Plan of work and small-fruit plats (pp. 101–105).—Brief preliminary notes on tests of varieties of strawberries, currants, gooseberries, raspberries, and blackberries in different parts of the State.

Notes on the black rot of grapes (pp. 106–109).—A reprint of an article in Bulletin No. 6, pp. 28–32, of the station (See Experiment Station Record, Vol. I, p. 196).

Insects injurious to crops in Delaware (pp. 109–111).—A list of 40 species of insects reported to the station as injurious to crops in Delaware in 1888.

Injurious insects, their identification and extermination (pp. 112–128, illustrated).—A reprint of an article in Bulletin No. 4, pp. 3–19, of the station (See Experiment Station Record, Vol. I, p. 22).

Answers to inquiries (pp. 128–133).—Notes on 9 species of insects regarding which inquiries were received at the station in 1889.

Experiments with insecticides (pp. 133–136).—This contains notes on an experiment in the use of London purple for the codling moth, reprinted from Bulletin No. 8, pp. 15, 16, of the station (See Experiment Station Record, Vol. II, p. 49), and on the successful use of hot water and pyrethrum powder as insecticides for the cabbage-worm (*Pieris rapæ*).

STOCK FEEDING, A. T. NEALE, PH. D. (pp. 137–163).—A reprint of an article in Bulletin No. 7, pp. 3–21, of the station (See Experiment Station Record, Vol. I, p. 196), with the addition of a detailed explanation by G. A. Harter, M. A., of the method of the least squares, as applied in determining the cost of the several nutritive constituents of feeding stuffs.

CREAMERIES, C. L. PENNY, M. A. (pp. 164–171).—This includes brief notes on investigations by the station regarding "(1) losses of butter in the separator process; (2) variations in the creamery value of milk from different herds, and variations in the same herd at different seasons of the year; (3) buying milk on test—the comparison of popular methods of testing milk with the standard processes of the laboratory." At the creamery at which the study was made 903 pounds of milk received on a certain day contained 38.2 pounds of butter fat, from which 35.91 pounds of butter were made. "Of the 2.29 pounds lost, 1.19 pounds were in the separated milk and 0.27 pound was in the buttermilk. The remaining 0.85 pound was the loss from various accidental sources, errors in weighing, analysis, etc." In other words, 6 per cent of the fat of the milk was lost in the butter making, of which 3.17 per cent must be charged to the separator, 0.7 per cent to the churn, and 2.13 per cent to incidental waste. The results of analyses of the milk of different herds of cows made at four different dates are summarized as follows:

Date.	Percentage of butter fat.			No. of pounds of the poorest milk equivalent to 100 pounds of the best milk.
	Maximum	Minimum.	Average.	
April 17	5.19	3.34	4.12	156
May 23	5.42	3.14	4.07	172
June 29	5.19	2.49	3.99	208
December 27	5.40	3.68	4.55	147

In the case of twenty-four herds studied it was found that the difference in the amount of butter fat in the best and poorest milk from any one herd on different dates was 20 per cent. "Of the remaining ten

herds the range of variation approximates 30 per cent in three cases, 40 per cent in four cases, and 60 per cent in three cases.

As to the expediency and justice of buying milk "by test" some strong arguments were found. The business of a small creamery for one day is taken as an illustration. Twelve hundred pounds of milk were received on an average per day from twenty-four dairymen, the price paid making the value of one day's raw material about $14.40. On the old system of sale by the pound, each dairyman would on an average receive 60 cents for his milk. By comparing the price paid with the relative richness in butter, it was found that some dairymen were underpaid 20 cents, receiving 60 cents for 80 cents' worth of milk, and that certain others were overpaid by as much as 14 cents. In both extremes the error was 20 per cent of the value of the milk. The average underpaid was 8 cents, and the average overpaid nearly 5 cents. In other words, the price of the poorer grades averaged 9 per cent above value, and of the better grades 12 per cent below value. In one day's business 72 cents justly due certain dairymen were paid certain others above their due. The purchaser neither gained nor lost directly by this transaction, since, in the long run, supply and demand fix his rates. The money paid for the poorer grades of milk in excess of their worth was taken from the pockets of men who sold better grades of milk, not from the purchaser.

Comparative tests of the lactocrite and Cochran's milk test with Soxhlet's areometric method of fat extraction are reported. The results with the lactocrite show errors about two thirds as great as where milk is sold without testing, while Cochran's method gave errors only one sixth as great.

Several articles of food known to be healthful found to contain small quantities of copper, C. L. Penny, M. A. (pp. 172–174).—A brief report on the results of analyses of grapes before and after treatment with Bordeaux mixture, and of molasses, oatmeal, flour, beef liver, and New Orleans sirup. The tabulated data show that a small amount of copper was found in every case. Grapes after careful treatment with the Bordeaux mixture, contained very little more copper than before treatment.

Report of meteorologist, G. A. Harter, M. A. (pp. 174–188).—Meteorological observations were begun at the station September 20, 1888, and a summary of the records from October 1, 1888, to December 31, 1889, is given in this report. The plan on which the observations are made is briefly described, and tabular data are given for rain-fall, temperature, and barometric readings, with the dates of thunder and hail storms, frosts, heavy rain-falls, and violent winds.

Georgia Station, Bulletin No. 8, July, 1890 (pp. 10).

Potato experiments, G. Speth (pp. 119–124).—"The importance of the potato crop in some parts of the State, especially near the larger cities, or where shipping facilities exist, has induced the station to undertake various experiments in the culture of the potato." The season of growth in 1890 was unusually dry and warm, so that the results of the experiments of this year were deemed unsatisfactory. Tabulated

data are given for 36 varieties tested; for a fertilizer experiment in which cotton-seed meal, acid phosphate, kainit, and muriate of potash, singly and in combination, and stable manure, were compared with each other and with no manure; for an experiment in which whole potatoes and one-eye and two-eye cuttings were planted; and for field tests of seeds of different varieties obtained from different parts of the United States. Stable manure and complete fertilizers gave the best results. Whole potatoes gave larger yields than the cuttings did. Southern seed gave better results than that from other sections. A small experiment in planting pieces of potatoes cut ten and five days before planting and on the day of planting gave results slightly in favor of cutting on the day of planting.

Georgia Station, Bulletin No. 9, October, 1890 (pp. 48).

POTASH AND PAYING CROPS (illustrated).—A reprint of a compilation prepared by the German Kali Works.

Indiana Station, Bulletin No. 32, July, 1890 (pp. 22).

TREATMENT FOR SMUT IN WHEAT, J. C. ARTHUR, D. SC. (pp. 3–9).—The publication of an article on smut of wheat and oats in Bulletin No. 28 of the station (See Experiment Station Record, Vol. I, p. 207) has served to bring information regarding the prevalence of smut in different parts of the State: "The stinking smut of wheat (*Tilletia fœtens*) is far more common than heretofore suspected, and has been especially abundant over a considerable portion of the northern part in the State during 1890. A loss of one half of the crop in certain fields has not been uncommon, and a careful inspection shows many fields affected where it was not supposed to occur."

Experiments at the station in the treatment of the seed of wheat with sulphate of copper and with hot water, as recommended by Jensen, are reported. Tabulated data are given, showing the effects of hot water at temperatures ranging from 51° C. (125° Fah.) to 75° C. (165° Fah.) on the germination of wheat seed immersed from 3 to 15 minutes.

The limit of vitality proved to be at 150° Fah. for 5 minutes, no germinations being obtained at the same temperature when continued 10 minutes, or at the higher temperatures used in the experiment. * * * The lots ranging from 135° Fah. for 10 minutes and upwards were injured to some extent by the treatment, none of them showing as large a total for either the first 24 hours or for the whole time, as the untreated seed. The injury to those treated at 135° Fah. for 10 minutes and at 140° Fah. for 5 minutes amounted to about 20 per cent, and to considerable more for the more strongly treated.

More complete experiments with oats, not yet published, have shown that the number of germinations during the first day holds a more important relation to the harvest than the total germinations. Assuming this to be true in the case of wheat, we find that the seed treated at 130° Fah. for 5, 10, and 15 minutes, and at 135° Fah. for 5 minutes, were materially benefited by the treatment, showing from 1.2 to 4.7 per cent advantage over the untreated. * * *

From all the data at hand we arrive at the conclusion that to treat seed wheat with hot water in order to prevent smut, it should be immersed for 5 minutes in water at 135° Fah.; if the temperature drops below this point the seed should be left in the water a little longer time, and if the temperature rises above it the time should be shortened. A greater variation than 5° above or below the 135° Fah. should be guarded against.

The loose smut of wheat (*Ustilago tritici*) caused a loss of 11 per cent of the crop of Original Red wheat and 24 per cent of Ontario Wonder, on the station farm in 1890, according to observations reported in this article.

FIELD EXPERIMENTS WITH WHEAT, W. C. LATTA, M. S. (pp. 10–18).—In 1890 these included tests of varieties, rates of seeding, times of seeding, large *vs.* small seed, rotation *vs.* continuous grain cropping, and experiments with fertilizers. For a previous account of similar experiments, see Bulletin No. 27 of the station and Experiment Station Record, Vol. 1, p. 206.

Test of varieties.—Tabulated data for 27 varieties tested in 1890, with the average yields of these varieties during from 1 to 7 years. Velvet Chaff has given the highest average yield (31.9 bushels) for the 7 years.

Quantity of seed to the acre.—Tabulated data are given for the yields of wheat seeded at rates varying from 2 to 8 pecks per acre during 6 years (1885–90). The yield for the 6 years has been from 19 to 31 bushels per acre, increasing with increased thickness of seeding.

(1) The yields from thin seeding are poor and fluctuating, while thick seeding shows uniform good yields. (2) There is quite a rapid increase in average yield from thicker seeding up to five pecks per acre, and a slight average increase for each higher rate. (3) The increase in yield from thick sowing is most marked in adverse years.

Early and late seeding.—Tabulated data are given for the yields of wheat sown in 1888 and 1889 at different dates from September 18 to October 18. The results are conflicting.

Large vs. small seed.—Seeds which passed through the seed screen of a fanning-mill were classed as "small"; those which did not pass through, as "large." Tabulated data are given for experiments in 1888 and 1889. The results slightly favor the use of large seed.

Rotation vs. continuous grain cropping.—"Experiments were begun in 1880 to determine the effect on the soil and on the crops of continuous grain production, as compared with judicious rotations, involving both grain and grass crops. No manure has been used on either series of plats, and the entire crop has been removed in every case. Grass (timothy and clover) constitutes the essential difference in the two series of plats. The effect of the two systems of cropping on the yield of wheat only will be noted here." The average yields per acre (bushels) of all the wheat plats of each series for the last four years are as follows: grass and grain, 18.6; grain alone, 14.9; gain from rotation, 3.7 bushels. "The yields of corn and oats also show the benefit of rotation. The smallness of the yields is due to the absence of manure."

Commercial fertilizers and stable manure.—"An extensive series of experiments has been undertaken to ascertain the effects on crops and soils, of various kinds and amounts of fertilizers and manures in connection with various systems of cropping. The cost of fertilization and profits resulting therefrom will be an important feature of the investigation."

Tabulated data for the yields of grain and straw, kinds and cost of fertilizers, and the gross and net profits from the use of fertilizers are given for the first year's (1890) experiments on two series of plats. In one series wheat and corn are grown alternately, with clover as an intermediate crop to be plowed under for corn; in the other, wheat is grown continuously. Dissolved bone-black, muriate of potash, and sulphate of ammonia, in combination, are compared with horse and cattle manure and with no manure.

Practical suggestions for wheat culture.—Careful experiment and observation emphasize the importance of attention to the following considerations to secure the highest success in wheat culture:

(1) A fertile, well-drained soil.

(2) Rotation of crops, with stable manure, or in place of the latter, green manuring, with commercial fertilizers that show good results.

(3) Early, thorough preparation of the seed bed.

(4) A hardy, prolific variety of wheat, suited to the soil and climate.

(5) A liberal quantity of seed, deposited evenly and not too deep in the soil.

(6) Sound, plump seed, absolutely free from all impurities, including the invisible spores or germs of black and stinking smut.

TWO EXPENSIVE FERTILIZERS, C. S. PLUMB, B. S. (pp. 19–22).—Analyses of two brands of commercial Fertilizers, Red Star Ferric Fertilizer and the Western Reserve Fertilizer, are given to show that the prices at which they were sold in the market in Indiana were exorbitant.

Indiana Station, Bulletin No. 33, October, 1890 (pp. 34).

SMALL FRUITS, J. TROOP, M. S. (pp. 25–35).—*Strawberries.*—Tabulated data for 108 varieties; lists of 10 varieties showing highest yield, best quality or largest size, or superior in two or more of the above-mentioned characteristics; a chart showing the comparative yield and quality of 10 leading varieties, and brief descriptive notes on 12 of the most promising varieties.

"The 5 most productive strawberries for this region are Bubach, Enhance, Hampden, Jessie, and Park Beauty. The 5 varieties of strawberries of best quality are Black Defiance, Crawford, Gandy, Henderson, and Sharpless." *Raspberries.*—Tabulated data for 11 varieties of red and 17 of black raspberries, with brief descriptive notes on 7 of the best varieties. "Brandywine and Cuthbert raspberries are two of the best red varieties, the latter for late. Tyler is superior to all cap raspberries." *Blackberries.*—Tabulated data for 17 varieties; Lucretia, Taylor, Snyder, Erie, and Minnewaski, in the order named, are recommended for family

use. *Currants.*—Brief notes on 9 varieties, which are recommended in the order named: Fay, Moore's Ruby, Wilder, Raby Castle, Red Dutch, White Dutch, Lee's Prolific, Crandall, and Black Naples. *Gooseberries.*—Brief notes on 4 varieties. "For the farmer's garden, Early Orange and Downing are recommended." *Grapes.*—Brief descriptive notes on 33 varieties. The black rot was prevalent in 1890, but was held in check at the station by the application of a mixture prepared according to the following formula recommended by the United States Department of Agriculture:

Dissolve 2 pounds of sulphate of copper in 2 gallons of hot water; in another vessel dissolve 2½ pounds of carbonate of soda in a similar manner; mix the two solutions, and when all chemical reaction has ceased add 1½ pints of commercial ammonia and dilute the whole to 22 gallons. This should be sprayed on the vines with a force-pump, at intervals depending somewhat upon the amount of rain-fall from the last of May till the end of July.

"For family use the following grapes are recommended for quality and productiveness: Concord, Delaware, Gœthe, Martha, Moore's Early, Wilder, Worden."

ENTOMOLOGICAL NOTES, F. M. WEBSTER (pp. 36–45).—Notes on experiments in rearing the plum curculio from plums and other fruits, reprinted from Insect Life, Vol. II, pp. 305–310 and 383; on the eggs and oviposition of the strawberry crown borer (*Tyloderma fragariæ*, Riley); on the field cricket and *Haltica ignita* as injurious to strawberries; and on *Solenopsis fugax*, *Limonius auripilis*, *Carpophilus brachypterus*, *Iulus impressus*, and *Cosmopepla carnifex* as enemies of raspberries and blackberries (See Insect Life, Vol. II, p. 257).

Iowa Station, Bulletin No. 11, November, 1890 (pp. 64).

EXPERIMENTS IN MAKING AND STORING HAY, R. P. SPEER (pp. 443–447).—"The report of the United States Department of Agriculture for 1889 shows that 3,600,000 acres of grass was cut for hay in Iowa in 1888. If the average yield was 1¼ tons of hay per acre, then the product of the State was 4,500,000 tons, which (at $4 per ton) was worth $18,000,000. By general observation and from my own experience in feeding hay I know that more than one third of the value of each of our hay crops is lost on account of late cutting, exposure to rains, dews, and the sun, and avoidable injuries while stacked or stored in barns."

The prevalence of rains and heavy dews during the haying season makes it difficult to cure grass and clover properly in Iowa. In clear, hot weather the hay is apt to dry too much in the field; it is also liable to injury from heating and "sweating" in stacks or barns. The experience of the author having shown that sweating might be prevented in the case of large stacks by building them around tall poles set in the ground, he was induced to try a similar plan in making small hay-cocks. Wood-pulp caps with a 1½-inch hole in the top were procured.

One-and-one-half-inch planks 14 feet long were cut into pieces 1½ inches square and 7 feet long with a rotary saw. Then, with a suitable plane, I plowed a deep groove in one side of each piece and sharpened one end and rounded the other so that it would pass through the hole in one of the hay caps. By a few trials in the clover field we found that it was best to build a hay-cock about 2 feet high, and then push the sharpened end of one of the little poles into it to the ground. Afterwards the cock was completed by building the hay around the pole. * * * In very small cocks of partially cured hay and in large cocks of wet grass or hay the poles did not have the desired effect, because the small and the large wet cocks did not heat readily, while in large cocks of wilted or partially dried clover they did have the desired effect when the surface of the leaves and stalks were dry. In every instance, when the heating process began within a reasonable time, the hay dried rapidly without being injured in color or substance.

Hay caps made of ducking were also successfully used. These should be soaked in a solution of sulphate of copper to prevent their being injured by mildew. The hay caps are relatively expensive ($40 to $50 per hundred at the station), but the author thinks it will pay well in Iowa to use them.

CULTIVATED AND WILD VARIETIES OF THE GRASSES IN IOWA, R. P. SPEER, C. M. WADE, B. S., AND G. E. PATRICK, M. S. (pp. 448–480).—"Blue-grass and the clovers do well in Iowa; but many of the cultivated grasses which are valued highly in moist climates have not given satisfaction on account of occasional severe droughts and cold winters. As we believed that some of the wild Western grasses might prove valuable under cultivation, the station collected the seeds of many native grasses in 1888 in Iowa, Minnesota, Dakota, Montana, Idaho, and Colorado, which were planted in rows on our experiment grounds in the spring of 1889. We planted seeds of many of the cultivated grasses also alongside of them at the same time in rows and broadcast, so that it would be easy to determine differences of growth and adaptation to our soils and climate."

Descriptive notes by R. P. Speer and analyses by C. M. Wade and G. E. Patrick are given for timothy (*Phleum pratense*), tall meadow oat grass (*Arrhenatherum avenaceum*), meadow fescue (*Festuca elatior* and var. *pratensis*), orchard grass (*Dactylis glomerata*), redtop (*Agrostis vulgaris*) from Idaho, wild timothy (*Phleum pratense*) from Idaho, cord grass (*Spartina cynosuroides*), ribbon grass (*Phalaris arundinacea*), large Iowa blue joint (*Andropogon provincialis*), panicled blue joint (*Chrysopogon nutans*), little blue joint (*Andropogon scoparius*), false redtop (*Poa serotina*), *Calamagrostis canadensis*, *Agropyrum violaceum*, Colorado blue stem (*Agropyrum glaucum*), short awned brome (*Bromus breviaristatus*), awnless brome (*Bromus inermis*), rye-grass (*Elymus canadensis*), common red clover, alsike clover (*Trifolium hybridum*), prickly comfrey (*Symphytum asperrimum*), Russian flax, asparagus, and prolific tree bean.

"We have tested sanfoin, *Lespedeza striata* (Japan clover), and three kinds of vetches, and have found that they are not adapted to Iowa.

The following worthless wild grasses have been tested for three years, viz.: *Stipa viridula, Festuca scabrella, Glyceria arundinacea, Agropyrum tenerum, Festuca rubra, Agropyrum repens, Panicum virgatum, Poa compressa*, Bermuda grass, Johnson grass, *Kœleria cristata, Sporobolus heterolepis*, and *Muhlenbergia glomerata*."

Analyses of samples of short awned brome, anwless brome, orchard grass, *Agropyrum violaceum*, and cord grass cut at different stages of growth showed in general that as growth proceeded there was a decrease in moisture and an increase in dry matter, and that in the dry matter there was a decrease in ash, crude fat, crude protein, and true albuminoids, and an increase in carbohydrates and fiber.

"The inevitable conclusion from the foregoing exhibits of the changes during growth is that the younger a grass is the richer it is in those ingredients which produce flesh, blood, milk, and wool, namely, the albuminoids; and that, therefore, immature grass or hay made from the same is very much better feed for either growing or productive animals than is the same grass, or hay made from it, when mature. This conclusion refers only to quality."

"In Iowa a faultless grass would begin to grow early in the spring; it would endure droughts well; it would not suffer from rust or other fungous diseases; it would be productive and grow continuously until late in the fall; it would be palatable and nutritious (especially rich in albuminoids); it would produce seeds plentifully; and it would not be injured by our most unfavorable winters." *Agropyrum glaucum, A. violaceum*, and timothy are discarded because they rust badly and do not stand drought; *Calamagrostis canadensis, Andropogon provincialis*, and cord grass, because they produce few seeds and are poor pasture grasses; *Poa serotina* and meadow fescue, because they do not yield satisfactory quantities of hay or pasture.

Andropogon scoparius, Chrysopogon nutans, redtop, tall meadow oat grass, Kentucky blue-grass, and white clover are considered by the author as useful in Iowa. *Bromus breviaristatus, B. inermis*, and red clover have given especially promising results. Alsike clover is not likely to be grown on a large scale in Iowa.

The chemical analysis of unripe bean stalks or vines indicates that it will pay well to grow the largest varieties of pole beans on hills of corn for fodder or silage. The chemical analysis of flax shows also that it is a very valuable hay plant if it is cut and cured when half of its seeds are ripe.

Our experiments in the field and the chemical analyses of asparagus and prickly comfrey are so satisfactory that we will try them on a larger scale for pasture and as soiling crops.

Experiments with alfalfa in 1888 on dry, sandy soil and in 1889 on "ordinary, black, well-drained soil" were unsuccessful.

CREAMERY AND DAIRY NOTES, G. E. PATRICK, M. S. (pp. 481–489).

Sweet cream butter, keeping quality.—As mentioned in Bulletin No. 8 of this station (See Experiment Station Record, Vol. II, p. 53), observa-

tions were commenced on the comparative keeping qualities of butters made from sweet and from ripened cream. The butters were both made December 14, 1889, at a creamery in Iowa. Until June 20, 1890, the two tubs were kept together in a cellar without ice, being examined about once a month; later they were placed in an ice chest, where they were kept to the close of the trial, August 20. The author sums up the results in the following words: "There was no very marked difference in the keeping quality of the two butters; what difference there was was in favor of the sweet cream produ t. As to flavor, for the first two or three months most of the tasters preferred the ripened cream butter, declaring that made from sweet cream to be comparatively 'flat,' 'insipid,' or 'flavorless;' but the longer the butters were kept, even while both were still sweet, the less marked became the difference between them in this respect."

Preservatives for keeping milk samples for testing.—In the directions for carrying out the "relative value plan" of paying for milk at creameries on the basis of the actual amount of butter fat as given in Bulletin No. 9, of the station (See Experiment Station Record, Vol. II, p. 101), samples of each patron's milk, taken daily, are to be preserved together by means of corrosive sublimate for about one week, when a single test is to be made to determine the average butter value of the milk of each patron during that time. In t ials since made with samples exposed not only to the natural heat of summer, but also to the heat of the greenhouse with a temperature of from 120° to 130° Fah , this preservative has given good results for the desired length of time. The fact of its being a violent poison, however, makes it open to serious objections, and investigations have been commenced in the hope of discovering some other preservative to take its place. A mixture of 50 parts by weight of powdered borax, 10 parts of mercuric chloride, and 1 part of aniline rose pink, thus reducing the amount of corrosive sublimate used in each composite sample to about 2 grains, has been used with success. Experiments made with preservatives containing no corrosive sublimate "while very numerous and extending throughout the entire past summer, I can not regard as conclusive." Those referred to are with amyl alcohol (fusel oil) 3 per cent by volume, and sodium fluoride 40 to 60 grains per 200 cubic centimeters of milk.

The Iowa Station milk test; new form suit ble for creameries.—The test as originally described has been somewhat modified for use at creameries. The modified method permits much more rapid work and the making of a larger number of tests at the same time. "A bath consisting of a tank lined with zinc, or preferably lead, with a steam coil in the bottom and containing a proper amount of saturated brine," is suggested for heating the tubes in place of the sand bath formerly recommended. The charged tubes containing the milk are supported in the bath by means of a rack. The formula of the acid mixture is somewhat modified and is as follows: nine volumes of pure acetic acid

(90 per cent strength), 5 to 6 volumes of sulphuric acid (specific gravity 1.83), and about 2 per cent of this mixture (by volume) of rectified methyl alcohol (wood spirit); in testing preserved milk 2 to 3 cubic centimeters of anhydrous sulphate of soda are to be added. "If three dozen or more tests are to be made at once the operator's time is spent almost entirely in the acts of charging tubes and reading results."

Graduated vs. ungraduated tubes.—"As stated in Bulletin No. 8, the greatest difficulty is met in obtaining from the makers tubes with accurate graduations. * * * A large number of tubes have been found perfect, but these comprise only a small part of the entire number tested; by far the larger part have ranged from 0.1 to 0.3 per cent too large or too small." The author is led from this to favor the ungraduated tube, to be calibrated and marked with the number expressing either the caliber or the cubic contents for a given length, the actual measuring of the fat being done with a millimeter rule, and the percentage found by reference to a table. "Such tubes have been calibrated under my supervision for the past six months."

Losses of fat in buttermilk.—Analyses of four samples of buttermilk from ripened cream which had been churned in an ordinary box churn showed an average of 0.6 per cent of fat; and sixteen analyses of buttermilk from another source, but also from ripened cream, averaged 0.49 per cent of fat. "These analyses indicate a loss of butter fat in churning which in general practice would amount to from 18 to 24 pounds in the first case, and in the second from 15 to 20 pounds for every 1,000 pounds of butter made.

POTATO STALK-WEEVIL, APPLE CURCULIO, AND A NEW CURRANT BORER, C. P. GILLETTE, M. S. (pp. 490–495, illustrated).—The potato stalk-weevil (*Trichobaris trinotata*, Say) was discovered by Mr. F. A. Sirrine, assistant botanist of the station, August 23, 1890, on the station grounds. As far as the author can learn this is the first time the insect has been observed in Iowa. Subsequent observations and inquiries indicated that it is generally distributed over the State. The insect in different stages is illustrated and its life history is briefly described. "The only remedy at present known is to pull the vines as soon as they are found wilting and drying and burn them. * * * As the potato stalk-weevil promises to be one of the worst insect pests of the State, it will be a subject of special study next summer."

Notes on the apple curculio (*Anthonomus 4-gibbus*, Say) are given, including an account of observations by the author on the oviposition of the insect, read before the Iowa Academy of Science, September, 1890.

"June 13, 1890, I was fortunate enough to see a female perform the entire operation, which was done as follows: First, a cavity was eaten in the apple as deep as the beak was long, the bottom being much enlarged and subtriangular in outline. The walls of the cavity converge to the opening, which is only large enough to admit the slender beak. It was thirty minutes before the egg cavity was completed. The beetle,

almost immediately after withdrawing her beak, turned about and applied the tip of her abdomen to the small opening into the egg cavity. After remaining in this position for about five minutes she walked away without turning about to inspect the work she had done. No puncture could be seen in the skin of the apple, but only a minute brown speck. I found that the beetle had plugged the little opening with what appeared to be a bit of pomace, probably excrement. * * * Although it is almost impossible to distinguish newly stung fruit from external appearances, it becomes very easy after a few days, when the infested apples become gnarly and ill shapen." The egg, egg cavity, and an apple infested by the curculio are illustrated from original drawings.

"The beetles began appearing in my breeding cages on July 22. On August 16 I cut into 14 infested apples and found 13 larvæ and 2 pupæ of this insect, and as late as August 7 I cut into an apple that contained a pupa of the apple curculio, which shows that with this insect, as with the plum curculio, egg laying is distributed through a long period. Oviposition begins in this part of the State about the first of June and continues until late in July, and the beetles are probably not all out of the fruit until late in August.

"Very few varieties of apples were seriously attacked in the college orchard by this insect last summer."

Treatment with arsenites, jarring the trees, and allowing hogs or sheep to run in the orchard are recommended as means for the repression of the insect.

Hyperplatys aspersus, Say, as well as *Psenocerus supernotatus*, Say, was found on currant bushes on the Iowa Agricultural College grounds in the spring of 1890.

KEROSENE EMULSION AS A SHEEP DIP AND AS A DESTROYER OF PARASITES ON DOMESTIC ANIMALS, C. P. GILLETTE, M. S. (pp. 495–498).—Previous experiments reported in Bulletins Nos. 5 and 7 of the station (See Experiment Station Record, Vol. I, pp. 45 and 213) having shown "that kerosene emulsion is a cheap, effectual, and desirable remedy" for lice on cattle and hogs, a test of this remedy as a sheep dip was made by the author in 1890. "Forty large, full-blooded Shropshire sheep and eighteen early lambs were treated. The applications were made June 23, at which time the wool upon the sheep was a half inch and the wool upon the lambs fully 1½ inches in length. These conditions made the test a severe one, as the chances of removing the fleece or otherwise injuring the sheep were far greater than if the treatment had been made at shearing time. The emulsion was also made strong, 8 per cent of the whole being kerosene. This is probably twice as strong as is necessary to kill ticks on sheep." Little injury was done to the wool, and the cost of the treatment was about 2 cents per sheep. By using a 5 per cent emulsion the expense might be reduced to a little over 1 cent per sheep. The experience of the author with horses, cattle, hogs, and sheep leads him to

believe that the kerosene emulsion, properly prepared, will not injure the hair of animals.

The conclusions drawn from the experiment with sheep, above cited, were "that a good kerosene emulsion of sufficient strength to kill parasitic insects can be used safely upon sheep without removing or injuring the fleece, but that an emulsion of poor quality should not be used, as it would probably cause the sheep to lose much of their wool.

"The emulsion should always be tested before being put into the vat by diluting a small quantity in a dish. If the kerosene should rise to the top the whole should be put in a vessel and heated to boiling and again emulsified. This boiling had best be done out of doors where there would be no danger from fire if the kerosene should ignite.

"Prepare the emulsion in the following manner: Dissolve one half pound of common hard soap in 1 gallon of water by boiling; while boiling hot remove from the fire and immediately add 2 gallons of kerosene and agitate the whole briskly for a few moments, when a creamy, frothy mass will be formed that can be diluted to any extent with water without oil rising to the surface. The emulsifying is best done with a small force-pump by pumping the material violently back into the vessel that contains it. In small quantities, nothing is better than an ordinary egg beater to emulsify the soap and kerosene."

THIRD ANNUAL REPORT, R. P. SPEER (pp. 499–502).—A brief outline of the work of the station in 1890. Among investigations not already reported in the bulletins of the station are analyses of sorghum, potatoes, and mangels, losses of butter fat in buttermilk, analysis of milk and butter for State dairy commissioner, and studies on cutworms.

Kansas Station, Second Annual Report, 1889 (pp. 370).

REPORT OF FARM DEPARTMENT, E. M. SHELTON, M. S., H. M. COTTRELL, M. S., AND W. SHELTON (pp. 6–89).—The work of this department of the station in 1889 was in the following lines:

(1) "Corn—varieties and methods of planting, cultivating, and harvesting; (2) wheat—varieties, fertilizers, and methods of cultivation; (3) forage plants, sorghums (saccharine and non-saccharine), millets, oats, etc.; (4) silos and feeding value of silage; (5) pig feeding, to show influence of foods on character of growth; (6) pig feeding, to test stock from mature and undeveloped parents; (7) steer feeding, to show the cost of growth (this experiment has not been completed)."

Experiments with corn (pp. 6–29).—(1) *Test of varieties.*—Tabulated notes are given for 47 varieties. The following table shows the more important variations of different classes of varieties grouped according to color of kernel or time of maturity:

	Yield per acre.	Time required in germination.	Stand.	Height of stalk.	Height of ear from ground.	Nubbins.
	Bush.	*Days.*	*Per cent.*	*Feet.*	*Feet*	*Per cent.*
Average of—						
White varieties	76	12	65	10	5	29
Red and mixed varieties	90	12	70	10	5	27
Yellow varieties	60	12	77	9	4.5	33
Early-maturing varieties	55	10 9	78	8	3.6	36
Medium maturing varieties	74½	11.9	70	9	4.6	33
Late-maturing varieties	82	12.9	59	11	5.9	26

This table shows that the average yield of the yellow varieties was the lowest; the average of the white varieties came next in order; and the average of the red and mixed varieties was the greatest. Many of the white varieties were from Southern seed, and not adapted to this climate. The average of the white varieties tested that are adapted to this locality was greater than that of the red and mixed sorts. Another season may change the relative position of these three classes. The average yield of the medium-maturing varieties was more than 9 per cent less and that of the early-maturing varieties 33 per cent less than the average yield of the late varieties. The time required in germination by the medium maturing varieties was one day more, and that required by the late varieties two days more than the time required by the early varieties. The per cent of stand was the highest with the early varieties and lowest with the late varieties.

(2) *Selection of ears for seed.*—Tabulated data are given for an experiment in which seed from ears of a medium-sized yellow dent variety, selected with reference to the number of rows per ear, was planted on six plats. The number of rows per ear varied from 12 to 22. The results varied irregularly, and further tests are necessary before conclusions can be drawn.

(3) *Distance of planting.*—An account of an experiment in which a medium-sized yellow dent (College Yellow) variety was grown on a clay-loam upland of moderate fertility, under conditions common to Kansas farms. The rows were 2½, 3, and 3½ feet apart, and the distance between stalks in the row varied from 4 to 16 inches. The results are summarized in tables.

The greatest total yield of corn and fodder was obtained when the stalks stood 4 inches apart in rows 3½ feet apart. The yield on these rows was, omitting unimportant fractions, 73 bushels of corn and 3 tons of fodder per acre, but only 14½ per cent of the corn was of marketable size. The largest yield of corn from any distance of planting was 73.77 bushels per acre, raised on row 3½ feet apart, with stalks 12 inches apart in the rows; 58 per cent of the ears from this planting were marketable corn. The season was favorable to close planting, as sufficient rain fell wherever needed, but the land was of poor quality. * * * The highest yield of fodder, 3.93 tons, was raised on rows 2½ feet apart, stalks 4 inches apart in rows. Where grain alone is desired, the wider planting will always give the greatest yield of marketable corn. The yield of fodder from the rows with stalks 4 inches apart was more than double the yield from the rows with stalks 12 or 16 inches apart, while its value for feed was much more than twice that of the fodder from the wide planting. The valuable portion of the feed, when corn is cut for fodder, is contained in the leaves and ears.

the stalk is worthless. Thick planting checks the rank growth of stalks, and increases the value of the fodder by increasing the proportion of leaves and grain. The ears from the thick planting are small and easily eaten by cattle, without needing to be broken, crushed, or ground. Corn fodder from corn grown in this way should always be fed without husking.

(4) *Listing vs. surface planting.*—Tabulated notes on an experiment in which these two methods of planting were compared show a gain of $3\frac{1}{2}$ bushels of corn per acre, or 4 per cent in favor of listing. The season was wet and thus very favorable to surface planting. In the dry season of 1888, the results of a similar experiment favored listing by nearly 15 per cent. By listing, corn can be planted with less time and labor, withstands drought and winds better, and requires less cultivation.

(5) *Methods of cultivating corn.*—Ordinary (three times), surface (2 or 3 inches deep), and excessive (four times) cultivation gave results which did not differ materially. This is in accord with numerous similar experiments on the college farm.

"Moderate cultivation, such as will keep the ground free from weeds, seems to be all that is required by the corn plant when grown on good soil in an ordinary season. The general experience seems to show that a greater amount of tillage may be profitable in a dry season or on poor land."

(6) *Harvesting for fodder and corn.*—"In 1888 a series of experiments were made to test the effect on yield of both fodder and corn of harvesting the crop at different stages of growth. The trials were made with several varieties of corn, and in two different soils, and every test showed a remarkable loss in cutting corn before the ear was hard and the leaves beginning to turn" (See Kansas Station Report for 1888, p. 42). These experiments were repeated in 1889 with only slight modifications. The corn was cut at four different stages of growth, in the milk, in the dough, when the grain was hard and the husk dry but the leaves yet green, and when left standing until the stalks were dead. Tabulated details and summaries are reported for 4 varieties of dent corn grown in one field and for King Philip corn grown in another field.

These trials have been made in two very different seasons in fields that differ considerably as to character of soil, and in each year with several varieties of corn (8 varieties in 1888, 5 varieties in 1889), and all show like results—a serious loss in the yield of corn whenever the stalks are cut for fodder. Even when the stalks are left, before cutting, until the husks are dry and the leaves begin to turn, there is still a loss of from 10 to 12 per cent in the yield of corn over that left standing. Considering all the facts shown in this experiment and in the experiment with corn planted at different distances, the inference seems plain that we must plant corn with the sole object of raising grain or with the sole object of raising feed.

Experiments with wheat (pp. 29–42).—A reprint of Bulletin No. 7 of the station (See Experiment Station Record, Vol. I, p. 214).

Forage crops (pp. 42–52).—Twenty-four varieties of forage crops were grown at the station in 1889. Brief notes are given for soja beans, teosinte, and Golden Wonder millet, which promise to be of value in

Kansas; and for cow-peas, serradella, and pearl millet, which have not been successfully grown at the station. There are also tabulated and descriptive notes on 8 varieties of the non-saccharine sorghums. "These non-saccharine sorghums resist drought well, and will give a good crop of both grain and forage in a season that is too dry for corn. These varieties are well adapted to poor soils. Where seed is chiefly desired, red Kaffir corn ranks first, with the common Kaffir corn a close second. Where forage and seed are both wanted, white millo maize is preferable. Kaffir corn stands the wind better on account of its shorter and thicker stalk. Brown dhoura has not received sufficient trial to warrant a conclusion on its merits." Eight Chinese varieties tested proved inferior in these trials. Brief notes are given for 8 varieties of millet. In an account of an experiment at the station with kohl-rabi it is stated that the yield in 1889 was at the rate of 758 bushels per acre, which was raised at the cost of a little more than 3½ cents per bushel. The purple kind is considered better than the green or "white" kinds. "The advantages which this crop possesses are: Insects do not injure it, drought does not prevent its growth, it keeps longer after being harvested than other root-crops, and a stand is easily secured." Tabulated and descriptive notes are given for 13 varieties of silage corn.

The ideal variety of corn for silage is one that has a tall, slender, short-jointed stalk, well eared, and bearing an abundance of foliage. The leaves and ears should make up a large percentage of the total weight, and the yield per acre should be heavy. The lower leaves should keep green until the crop is ready to harvest, and it is desirable to have the plant stool well and throw out tall grain-bearing suckers. For this State a silage variety should mature late—the later the better—as a long-growing, late-maturing sort will furnish much more feed, from a given area, than one that ripens early.

No one variety that has been tried here possesses all these qualities. Among those that approach nearest are the Southern Horse Tooth, Shoe Peg, Brazilian Flour corn, Bullock's White Prolific, B. and W., and Red Cob Ensilage.

The following varieties of winter oats tested at the station are recommended as valuable for pasturage: Gray Winter, Virginia Winter, and Blue Grazing Winter.

Silos and silage (pp. 53–65).—This is a reprint of Bulletin No. 6 of the station (See Experiment Station Record, Vol. I, p. 46), with the addition of brief notes on experiments in storing silage in a field pit and in steaming silage. An excavation some 30 feet long, 15 broad, and 2½ deep was made in a corn field. In this pit corn stalks with the ears were carefully piled in October and rolled with a heavy iron roller. The stalks were then covered with 4 inches of straw and 20 inches of earth. When the pit was opened late in December the silage was found to be in very excellent condition. This experiment leads the author to suggest that this method of storing silage might be very useful where there is a dry, sandy, friable soil in which a pit with a capacity for 100 tons of stalks might be dug at very slight expense and filled without the use of expensive machinery. Three experiments were tried, in which

steam was forced through a mass of silage which had just been put into a silo. In every case the silage thus treated was found to be spoiled when the silo was opened two or three months after the steaming.

Experiments with pig feeding (pp. 65–88, illustrated).—A reprint of Bulletin No. 9 of the station (See Experiment Station Record, Vol. I, p. 216).

Pigs from mature and immature parents.—"A large proportion of Kansas swine breeders breed sows when eight or nine months old. After weaning the pigs the sow is fattened and sold and her immature offspring bred to furnish the supply of pigs required on the farm. A young boar is generally used, so that the whole herd is composed of immature animals, the offspring of immature parents. Many careful farmers object to this system of breeding, claiming that it is less profitable than that when mature hogs are coupled together, and, further, that when this system of breeding from immature animals is continued the vitality of the stock is injured and greater loss sustained from disease.

"The object of this experiment was to ascertain by actual trial what results could be obtained in breeding and feeding from mature and from immature animals. The plan adopted was to select two closely related, pure-bred Berkshire sows, one mature and the other young; the mature sow was to be bred to a mature boar, the young sow to an immature boar. Each litter of pigs was to be fed separately from birth until ready for market, and an accurate record kept of feed consumed and gain made. A sow pig was to be taken from the immature sow's litter and bred, while yet growing, to an immature boar, and her pigs fed against a litter of pigs from mature parents. This method of selection and feeding was to be continued for a series of years."

In the trial of 1888 a sow three and one half years old was bred to a boar five and one half years old, and a sow seven months old was bred to a boar eight months old. The mature sow farrowed nine pigs and the immature sow eight pigs. "Throughout the experiment the pigs of both litters were given all the feed they would eat, and the two litters were fed as nearly alike as could be done and keep them gaining satisfactorily."

Tables show the kinds and amounts of feed, the weight and gain in weight of the sows and pigs, and the cost of feed for each week from birth to weaning and from weaning (June 11) to February 25. Between the days named "the mature sow's pigs made a gain of 2,165 pounds, at a cost of $48.72, or 2.25 cents per pound. The young sow's pigs made a gain during the same period of 1,411 pounds at a cost of $36.52, or 2.58 cents per pound, one third cent more per pound than for the mature sow's litter. * * * The mature sow had nine pigs; one pig was lost by disease, leaving eight pigs that could have been fed for market. The young sow had eight pigs; three were lost by disease, leaving only five that could have been fed. It was noticed throughout the trial that the pigs from mature parents ate the most feed per head,

eating with better appetites. The results of the trial for this year (1888) are that the pigs from mature parents weighed more at birth, ate more feed, and made a greater gain for feed consumed, and that a greater number lived to maturity."

In the trial of 1889 the mature sow was twenty months old when bred to a boar fifteen months old. The immature sow (taken from the immature sow's litter of 1888) was eight and one half months old when bred to a boar seven and one half months old. The mature sow farrowed nine pigs and the immature sow seven pigs. The details of the experiment are given in tables as for the trial of 1888:

Between July 8 and December 23 the mature sow's pigs made a gain of 767 pounds at a cost of 2.8 cents per pound, and the immature sow's pigs made a gain of 610 pounds at a cost of 2.86 cents per pound. The average weight of the pigs in each litter was 136 pounds. One pig of the immature sow's litter died May 13; all of the mature sow's pigs lived. Neither litter fed satisfactorily at any time during the trial, but those in charge were unable to ascertain the cause.

Further trial seems necessary before any positive conclusion can be drawn from this experiment. In the trial of 1888 the pigs from mature parents were the most profitable; in the trial of 1889 there was little difference between the two litters.

REPORT OF CHEMICAL DEPARTMENT, G. H. FAILYER, M. S., AND J. T. WILLARD, M. S. (pp. 90–132).—Reports are given of the results of work in 1889 in the following lines: a comparison of 125 varieties of sorghum; improvement of sorghum by seed selection; crossing of varieties of sorghum; time of planting sorghum; a comparison of different-sized stalks of sorghum; the composition of feeding stuffs; the composition of corn at different stages of growth; ammonia, nitric acid, and nitrites in atmospheric water.

Sorghum, comparison of varieties (pp. 90–101).—Owing to attacks of chinch-bugs and to other causes stated in the report the experiments with sorghum in 1889 were not very satisfactory. All the varieties grown in 1888 were replanted, together with several varieties obtained from the United States Department of Agriculture, and 153 varieties received from the New York State Station.

Tabulated notes on the samples taken for analysis and on the results of the analysis are given for over 80 varieties, including a number from India, China, Java, and Africa.

Sorghum, comparison of different-sized stalks (p. 102).—"An analysis was made to determine what difference, if any, exists in the value of large canes as compared with small ones. All of the canes for a certain distance in a row of Kansas Orange sorghum were taken and divided into three parts, containing, respectively, the largest, the smallest, and the medium-sized canes. These divisions were analyzed separately; the details of the results are given in a table. Taking the percentages as calculated on the juice it would seem that the value of the cane increases as the size diminishes, there being an increase in cane sugar and total sugars and a decrease in reducing sugar. But as the smallest canes yielded a smaller percentage of juice, the calculation has also

been made showing the per cent of sugars extracted in the juice, but calculated on the weight of the dressed cane. From this it will be seen that the medium-sized stalks yield in grinding the largest per cent of total sugars, but the proportion of reducing sugar is greater than in the smallest canes. For sugar making there is probably little difference between the smallest and the medium canes, while the largest are inferior to these."

Sorghum, improvement by seed selection (pp. 102–105).—Tabulated notes of the results of analyses of sorghum of different varieties grown from the "best," "poorest," and "average" seed as determined by the sugar content of the stalks from which the seed was grown. Injury to the crop by chinch-bugs materially interfered with satisfactory results from this experiment. The selection of superior individual canes has been continued and seed from these will be planted another season. Analyses of nearly seven hundred stalks from fourteen varieties were made in 1889 and the results are summarized in a table. "The highest per cent of cane sugar obtained was 16.9 in a stalk of Link's Hybrid. Stalks of Kansas Orange and Late Orange, however, showed a higher per cent of total sugars, the highest being 18.9 in Kansas Orange."

Sorghum, crossing of varieties (pp. 105–107).—In 1888 some forty varieties of sorghum were grown side by side; from these selections of seed were made, which were planted in 1889. The crop from this seed showed a considerable number of crosses. This is contrary to the opinion of some authorities on sorghum culture, who have maintained that varieties of this plant have little or no tendency to cross. Tabulated notes on analyses of a number of crosses obtained at the station are given.

Sorghum, time of planting (p. 108).—Four varieties were planted at four different dates at intervals of eight days, beginning with April 16.

The earlier plantings germinated less satisfactorily and made a slow growth. They matured somewhat earlier than the later plantings, but there was no perceptible difference in the two first plantings, and scarcely any between these and the third. The character of the season, however, had much to do with the slow growth of the early plants; it was a cold and backward spring until about the first of May. The lesson, however, is obvious: It is a loss and not a gain to plant before the soil is warm. But the ground should be ready to take advantage of the first warm, growing weather. The plant must be fully matured to get the best results, and the season will be lengthened by planting to utilize this earliest warm weather.

Analyses of feeding stuffs (108–120).—The technical terms used in reporting analyses of feeding stuffs are explained, a brief account is given of the functions of the various food ingredients for nutrition, and the methods of analyses of feeding stuffs employed at the station are described. The methods of analysis were those adopted by the Association of Official Agricultural Chemists, with certain modifications described in the report. A table gives the results of analyses of the seed of Kaffir corn, sorghum, and millo maize, and of corn chop, bran, shorts, ship stuff, sorghum leaves, hay, cotton-seed meal, turnips, ruta-

bagas, beets, and purple and green kohl-rabi. The analyses of kohlrabi show a relatively large proportion of nitrogen in other forms than in that of the albuminoids. "In the case of the purple-topped variety, only one fourth of the total nitrogen is albuminoid. With the green-topped variety the albuminoid nitrogen is slightly greater, but the total per cent of nitrogen is considerably less. * * * Analyses of turnips, ruta-bagas, and beets showed that of the total nitrogen of beets, less than 24 per cent was in albuminoids; of ruta-bagas, less than 44 per cent; and of turnips, less than 35 per cent. The beets contained a large percentage of nitrates." The analyses of the seeds of three varieties of sorghum show that these seeds have nearly the same composition as corn. The smaller size and greater hardness of the sorghum seed may lead to its imperfect digestion by animals. The analyses of sorghum leaves show that they have a relatively larger amount of ash; otherwise they compare favorably with hay.

Composition of corn at different stages of growth (pp. 120–123).—Samples of corn obtained in the experiment recorded in the annual report of the station for 1888 were analyzed, and the results are stated in a table in this report. The corn had been cut at four or five different stages of growth from August 8 to September 4. The table shows that with one exception the fat and nitrogen-free extract increased proportionally as the grain developed, while the fiber, ash, and nitrogenous materials decreased. The difference in the yield of corn at the several cuttings was striking. "In the case of yellow dent, a yield of 15 bushels of corn in the dough increased to 39 bushels by the time it was ripe, and the quality was sensibly the same. King Philip increased from 30 bushels to 61 of equal quality."

Ammonia and nitric acid in atmospheric waters (pp. 123–132).—The collecting and analyzing of rain-water at the station was commenced in March, 1886, for the purpose of determining the total amount of nitrogen brought down by rain and snow per acre yearly. During the first year only the total nitrogen was determined, but since that time the ammonia and nitric acid have been determined separately. During three and a half years separate analyses were made of samples from each rain-fall, but since that time average samples of the rain for each month have been analyzed. The methods of analysis used are described. Details of the observations, including rain-fall, total nitrogen, and nitrogen as ammonia and as nitric acid, for each rain during the year ending March 1, 1889, and for each month during four years, are given in tables. A general summary of the results for the four years shows the average total nitrogen in the rain-fall per acre to have been 3.44 pounds per year; nitrogen in the form of ammonia, 2.63 pounds; and nitrogen in nitric acid 1.06 pounds. A brief resumé is given of European and other observations on this subject. From May, 1887, to September, 1889, the rain-water was tested for the presence of nitrites. Twenty-eight per cent of the rains falling in December, January, February, and March,

and 89 per cent of those falling in June, July, August, and September contained nitrites. "This points to a less favorable condition for the production or conversion of nitrites in winter than in summer."

REPORT OF DEPARTMENT OF HORTICULTURE AND ENTOMOLOGY, E. A. POPENOE, M. A., F. A. MARLATT, B. S., AND S. C. MASON (pp. 133–212, illustrated).—"The present report covers the work of this department during 1889 in the following lines: comparative trial of garden beans; further trial of peas, tomatoes, and potatoes; notes on bean insects. Experimental work in progress in forest-tree planting, in propagation of woody plants by cuttings, on vineyard and small fruits, in trials of lawn plants, and in other lines of work in horticulture, with other studies of injurious insects, is not here included, being reserved for more complete report in future publications."

Beans, test of varieties (pp. 133–151).—Tabulated and descriptive notes on 59 varieties of bush beans, 22 of pole beans, and 10 of Lima beans.

Peas, test of varieties (pp. 151–168).—Tabulated and descriptive notes on 137 varieties.

Potatoes, test of varieties (pp. 168–198).—Tabulated notes on 225 varieties planted April 23 and 24, with brief descriptive notes and estimated yield per acre; longer descriptive notes on 33 varieties which had not previously been tested at the station; tabulated notes on 56 varieties of early potatoes planted March 15.

Tomatoes, test of varieties (pp. 198–206).—Tabulated notes on 81 varieties with descriptive notes on 22 varieties.

Some insects injurious to the bean (pp. 206–212).—Notes on the bean weevil (*Bruchus obsoletus*, Say); bean-leaf beetle (*Cerotoma caminea* Fabr.); *Agalliastes bractatus*, Say; and *Halticus minutus*. The species described are illustrated in a plate.

REPORT OF BOTANICAL DEPARTMENT, W. A. KELLERMAN, PH. D., AND W. T. SWINGLE, B. S. (pp. 213–360).

The loose smuts of cereals (pp. 213–288, illustrated).—This contains a somewhat extended summary of available information concerning oat smut (*Ustilago avenæ* and var. *lævis*), loose smut of wheat (*Ustilago tritici*), covered smut of barley (*Ustilago hordei*), and naked smut of barley (*Ustilago nuda*). Among the topics treated are history of the species, injuries to the host plant, varieties attacked, amount of damage, geographical distribution, botanic and microscopic characters, germination in water and in nutrient solution, infection of the host plant and methods of treatment. Details are given of the damage by smut in fields of oats near Manhattan, Kansas, in 1888 and 1889; of the germination of smut, in water and in nutrient solutions; and of the treatment of smut at the station with sulphate of copper solution and with hot water as recommended by Jensen. There are also brief notes on five natural enemies of the smut, viz., two species of black mold, a bacterial blight, and two species of smut-eating beetles; and a short account of the stinking smut of wheat. This article is illustrated with nine plates,

containing a large number of figures, showing the grain as affected by the loose smuts, the germination of the different species of smut, and the natural enemies referred to above.

Experiments in crossing varieties of corn (pp. 288-334, illustrated).—A report on an experiment in crossing varieties of dent, flint, and soft corn, similar to that reported in the First Annual Report of the station for 1888, page 316. Fifty-six different varieties were used, 45 of dent, 9 of flint, and 2 of soft corn. A summary of the results with each kind of corn is given. The whole experiment is summed up as follows:

Number of crosses attempted, 188; number of crosses successful, 175 (or 93 per cent); ears too defective for comparison, 6; no evidence of cross manifest, 104 (or 62 per cent); doubtful evidence of cross, 27 (or 16 per cent); evidence of cross manifest, 38 (or 22 per cent); evidence in color only, 29 (or 17 per cent). Our results show in common with those of others that the so called varieties of maize cross more or less freely, and the effects may or may not be visible the current year. * * * Here, however, might be mentioned more fully the work of Dr. E. Lewis Sturtevant, as reported in the New York State Station Report for 1884, pp. 148-154. Instead of artificially fertilizing the pistils of any variety with pollen from another, he planted the numerous sorts of corn together, so that the pollen being distributed by natural agencies might have a fair opportunity to fertilize the several varieties indiscriminately. He judged of the fact of crossing solely by the visible effects, and his propositions are based on experiments and observations extending over several years. The first, namely, that maize does not in general show the effects of current cross-fertilization, the exception being sweet-corn, may be said to be confirmed in part by our results. Yet, in case of the experiments in 1888, 7½ per cent of the crossed ears of the dent, flint, and soft varieties exhibited unmistakable evidence of the crossing, and 19 per cent showed the effects doubtfully. In case of the crosses made in 1889, 24 per cent of the ears showed evidence of the cross and 12½ per cent were doubtful.

Our experiments during the past two years do not show, as Dr. Sturtevant's do, that the agricultural species* have a strong tendency to resist cross-fertilization with each other. By consulting our tabulations and summaries it will be seen that dent, flint, soft, sweet, and pop-corn cross as freely with each other as with the different varieties in their own class. The confirmation of this statement depends in part on the effects seen in the second generation (which see in the article that follows, namely, Crossed corn the second year).

According to Dr. Sturtevant, "where cross-fertilization has taken place in maize the tendency is to produce both parental types, and not toward intermediates." We find that the cross the first or current year is sometimes intermediate in character of grains. The second year's product may show exact intermediates, and in no case are the ears exactly like either parent.

In cross-fertilization variation in color is commoner than variation in other characters. About one half of the crossed ears which exhibit the effect of the crossing the first year show it in color only.

With a view to improving certain leading varieties crosses of 9 of these varieties were made, with a number of others, as stated in the report. The details of all the experiments in the cross-fertilization of corn at the station in 1889 are given in a table which fills fifteen pages, and includes the name of the variety, the date of inclosing the ear with

* The agricultural species are given by Dr. Sturtevant as follows: *Zea saccharata*, sweet-corn; *Zea indurata*, flint corn; *Zea indentata*, dent corn; *Zea amylacea*, soft corn; *Zea everta*, pop-corn.

the cloth sack, the date of applying the pollen, name of variety furnishing the pollen, the result of the crossing, the date of inclosure of the tassel in order to secure pollen, and the name of the variety fertilized with this pollen. Descriptive notes on the 175 ears obtained as the result of the crossing fill twenty-six pages.

Crossed corn the second year (pp. 334–346).—Of the crosses obtained in 1888 (See Kansas Station Report for 1888, p. 316), the twenty-three ears with sound kernels were planted April 4, 1889, in small adjacent plats, so arranged "that the plants of contiguous plats discharged their pollen at different times, thereby lessening the chances of intermixing." A list of the varieties from which the crosses were obtained is given, together with descriptive notes on the growth of the corn from each of the crossed ears planted.

In every case the effect of the cross could be plainly seen. This was true, both for those which did not show and for those which did show the effect of the cross the first year. In no case, therefore, did the ears exactly resemble either parent. The cross resembled the one and sometimes the other parent more closely, with apparent capriciousness. There were two well-marked types of variation, namely, (1) in which the kernels on each ear were uniform, and (2) in which the kernels were more or less variable; but a few numbers were intermediate. Of those of type 1, the majority were intermediate between the parental varieties, but in many cases a few ears could be found which were more like one or the other parent, and often showed little influence of the cross. * * * Of those of type 2, some ears were nearly uniform. while others varied considerably. In some cases kernels almost like one or the other parent constituted the bulk of the ear, while the strictly intermediate ones formed but a small proportion. * * *

All of the numbers planted which showed the effects of the cross the first year presented the variation of type 2. Of the six numbers which showed doubtful evidence of the cross last year two (24 and 40) showed variation plainly of type 2; three (8, 11, and 41) were of type 1, and one (14) was intermediate. Of the remaining fourteen numbers, three (3, 7, and 15) showed variation of type 2; eight (2 4, 5, 19, 20, 21, 25, and 26) showed type 1, and three (9, 17, and 27) were intermediate.

These results seem to suggest that when the effects of the cross are manifest the first year the variation is more likely to be of type 2 the second year, but if they are not manifest, the variation to be expected is oftener of type 1. A table shows the type of variation of the crosses arranged according to the different kinds crossed. * * * It is quite probable that several of these crosses will prove to be of value, and accordingly an effort will be made to fix or retain their important characteristics in the product of successive years.

Bibliography of fertilization of varieties of corn (pp. 346–353).—A list of 23 articles, arranged chronologically, with a brief summary of each article.

Preliminary study of the receptivity of corn silk (353–355).—A limited number of trials and observations in this line were made in connection with other work on the corn plant. The variety of corn treated was Leaming. Cloth sacks were used to prevent the contact of pollen except as desired. The methods of treatment were as follows: (1) the silk exposed from two to ten days after its first appearance and not reinclosed; (2) silk exposed during one day and then reinclosed; (3) silk exposed until $1\frac{1}{2}$ inches long and then inclosed; (4) silk exposed

by splitting the husk, after which pollen was applied and the ear inclosed; (5) silk exposed when from fifteen to thirty pistils protruded, after which pollen was applied and the ear inclosed; (6) the silk (not previously inclosed) was cut off and exposed when from $1\frac{1}{2}$ to $3\frac{1}{2}$ inches long; (7) the silk previously inclosed was cut off and exposed when from 4 to 6 inches long.

While the trials are entirely too few in number to base generalizations on them, it may yet be noted that some of the results accord with common observations. Thus, (1) The best results are obtained when the silk receives the pollen within a few days after its first emergence; after six or eight days the ears obtained are not perfect. (2) Exposure of the silk but one day does not suffice for the fertilization of all the grains. (3) When the silk was exposed until $1\frac{1}{2}$ inches long and then inclosed so as to prevent further pollination the ears were perfectly filled. (4) In one case the silk was exposed by splitting down the husks, yet many of the pistils (silks) proved to be receptive. (5) When a few pistils only protruded, and were dusted with pollen, still fewer grains were produced in two cases; in the third case two more grains were produced than the number of protruding pistils. (6) When the tips of the pistils (silks) are cut off, fertilization is not prevented; normal fertilization, however, is usually interfered with, but in some cases nearly perfect ears may result.

Maine Station, Annual Report, 1890, Part I (pp. 16).

INSPECTION OF FERTILIZERS.—"The Station Report for 1889 shows that in that year 43 brands of fertilizers were inspected. In 1890 the number of brands has been increased to 64, including 7 brands of bone." The report contains a statement of the trade values of fertilizer ingredients agreed upon by the stations of Massachusetts, New Jersey, Pennsylvania, and Connecticut, and analyses of 64 samples of commercial fertilizers, including bones.

"Heretofore separate analyses have been made of the three samples representing the same fertilizer. This year equal quantities of the three samples have been mixed, and an analysis of this mixture has been assumed to give the same result as would be reached by averaging the analysis of the three samples."

Maryland Station, Second Annual Report, 1889 (pp. 163).

REPORT OF DIRECTOR, H. E. ALVORD, C. E. (pp. 3–17).—The excessive rain-fall of 1889 (about 60 inches) materially interfered with the success of the experiments in progress at the station. "The effect upon the growing season is better shown by the fact that the excess of rainfall in this vicinity, from April 1 till October 1, was 75 per cent. At this station rain fell on 144 days in the year; the sun was not visible at all on 86 days out of 244 days included in this record, and there was but one third of the sunshine due according to the almanac for this period of eight months. * * * In making choice of subjects for investigation at the station, attention was early directed to the great and growing interests connected with the canning or packing of vegetables and fruits

in this State and the crops which contribute to this industry." Tomatoes, for example, are very extensively grown in Maryland both for the market and for canning. "The 'tomato pack' of the whole country was estimated at 3,343,000 cases in 1888, and 2,977,000 cases in 1889. To this aggregate Maryland contributes over 23 per cent, or nearly one fourth. The quantity annually canned being from 30,000 to 35,000 tons, there must be at least 40,000 tons of tomatoes ripened yearly in this State, representing the product of 12,000 acres of land." Accounts of investigations on tomatoes by the station are given elsewhere in the report.

"A similar course of inquiry regarding sugar corn as a canning crop was initiated, but circumstances compelled its abandonment at an early period, to be renewed in a more propitious season."

The acreage of tobacco and the quality of this crop having declined in Maryland in spite of the fact that large areas of the State are peculiarly adapted to this plant. The station, in co-operation with tobacco planters in several counties, undertook inquiries in the following lines: "(1) Can not Maryland tobacco be improved in quality, first, by introducing new varieties of the plant; or, second, by special feeding or other treatment of the kinds commonly raised in the State? (2) Can not the product per acre of tobacco be increased, first, by special fertilizers or methods of manuring; or, second, by new or improved methods of cultivation?" No results worthy of record were obtained in 1889.

A report on feeding trials with cattle, sheep, and swine is to be published in Bulletin No. 7 of the station. The expediency of co operation in investigations by stations in neighboring States is urged.

Upon the invitation of the United States Department of Agriculture, this station co-operated with certain divisions of that Department during the season of 1889, in promoting three lines of investigation: (1) special feeding of cows and making butter from them, to ascertain the effect of peculiar food upon the composition of butter. (2) Growing sorghum in great variety and considerable quantity, under different conditions, as an adjunct to the sorghum-sugar experiments by the chemist of the Department. (3) Raising mulberry trees of different kinds for the information and use of the Silk Section of the Department.

A number of examinations have been made of peculiar and of characteristic soils in different parts of the State, and the investigation of the marl deposits of the eastern portions of Maryland has been renewed. Full descriptions of the samples taken and the results of their chemical analyses are given in the report of the station chemist. This work will be continued, and particularly that part of it relating to the marls.

Reference is made to former investigations of Maryland marls by Prof. J. T. Ducatel, State geologist, and others, as published in State reports of 1834–40; by Dr. James Higgins, State agricultural chemist, reported in 1852–58; by Prof. P. T. Tyson, State agricultural chemist, reported in 1860 and 1862. "Prof. P. R. Uhler, president of the Maryland Academy of Sciences, has lately pursued a geological study of the tide-water portions of the State, and added valuable contributions to previous knowledge of the marl deposits."

In the spring of 1889 the horticulturist of the station, assisted by the local granges of the Patrons of Husbandry, collected samples of seeds sold throughout the State. "They were examined with reference to their purity and vitality, and some were grown to determine trueness to name." It was deemed inadvisable to publish a detailed record of these tests.

The general result of this examination was to furnish conclusive proof that the supply of vegetable and garden seeds offered for sale in the State is good, satisfactory in quality, and reasonable in quantity for the prices. Only in exceptional cases were seeds found impure or lacking in vitality or germinative power. The general freedom from impurities show that, as a rule, proper care is taken in cleaning the seed before it is offered for sale. This statement does not include field seeds. Grass and clover seeds were found to often contain much foreign matter, partly worthless and partly injurious. * * * The average of germination for samples tested of all classes was over 75 per cent. There was a marked difference in the vitality of different kinds of seeds; for instance, lettuce seed has always a very high rate of vitality (94 per cent or over), while carrot and cauliflower seed are usually of low vitality (ranging from 53 to 64 per cent).

"The library has been increased, important additions have been made to the laboratory equipment, microscopes and accessories have been purchased, and a complete photographic outfit obtained, including the fitting up of a suitable dark room.

"A commodious and well-arranged building for stable and storage has been erected, 40 feet square, with 16-foot posts and a hipped-roof, giving great capacity in the loft."

During 1889 the station made exhibits at the county fairs and at the exposition of the State Agricultural Association at Pimlico. "Members of the station staff, assisted by students of the senior class of the college, were in attendance in all cases to explain the exhibits, distribute bulletins, and give information regarding the station and its purpose. These displays attracted much attention and were favorably commented upon." The exhibit made at Pimlico is briefly described. Station officers attended agricultural meetings in eleven different counties of the State. Within the year representatives of nearly all the prominent organizations in the interest of farming have visited the station. The Maryland State Farmers' Association and the State Grange have both appointed standing committees to inspect the station and its work and periodically report upon its condition and management. Visits from progressive farmers individually interested in the work are also becoming frequent.

The publications of the station during 1889 were the First Annual Report, Bulletins Nos. 4, 5, 6, and 7, and a Special Bulletin for distribution at the agricultural fairs. Editions of from 4,000 to 10,000 of these publications have been distributed. The station also carried on a large correspondence.

THE TOMATO, DR. R. L. STURTEVANT (pp. 18–25).—A brief history of the tomato in Europe and America, with especial reference to the

origin of the different classes of varieties. The author regards it probable that botanists will ultimately refer all varieties of tomatoes to two species, *Lycopersicum cerasiforme* and *L. pimpinellifolium.*

REPORT OF HORTICULTURIST, W. H. BISHOP, B. S. (pp. 26–66).—This includes articles under the following heads: (1) variety test with tomatoes; (2) fertilizer test with tomatoes; (3) potato experiments; (4) comparison of seed potatoes from Vermont and Maryland; (5) general notes on vegetables; (6) orchard and small fruits.

Variety test with tomatoes (pp. 26–43).—General notes on the test of varieties of tomatoes at the station in 1889, together with tabulated data for 60 varieties, and brief descriptive notes on 16 varieties. The following summary is taken from the report:

(1) The larger the fruit the greater the number of cells; this holds true not only with the fruits of different varieties, but with the fruits of a given variety, compared with each other.

(2) The larger the number of cells the greater the solidity of the fruit as measured by the proportion of solid flesh to seed and pulp.

(3) The larger the fruit the smaller the proportional number of seeds.

(4) In general terms the varieties producing the larger fruits are among the heaviest bearers.

(5) The most promising varieties for general culture are Ignotum, Paragon, Favorite, Belle, Fulton Market, and New Jersey.

(6) The earliest varieties this season were Conqueror, Earliest of All, and Alpha. To these may be added Bermuda and Advance.

Fertilizer test with tomatoes (pp. 43–51).—A piece (63 by 216 feet) of light clay-loam, mixed with gravel, was divided into twelve plats, 63 by 17.3 feet, each containing one fortieth of an acre. Fourteen varieties of tomatoes were set in as many rows extending the whole length of the series of plats. The plan was that each variety should be represented on each plat. Nitrate of soda, dissolved bone-black, and muriate of potash, singly, two by two, and all three together, and dried blood were applied on eleven plats, one plat being unfertilized. The death of a number of plants before fruiting prevented the making of a complete record of all the varieties on all the plats. Results are stated in three tables showing the comparative yield on different plats, the total yield, the ounces and number of fruits of each variety on each plat, the average yields of 14, 5, and 2 varieties on each plat. The indications were "that the regulating ingredients in a fertilizer for tomatoes on this soil are nitrogen and potash, while phosphoric acid has less effect." There are also brief notes on a box experiment in which the same fertilizers were used as in the field experiments; owing to the fact that roots of some of the plants escaped from the boxes, no details of this experiment are given.

Potato experiments (pp. 51–55).—In Bulletin No. 2 of the station were reported the results of a trial of different quantities of seed potato, based on the yield of small plats. In 1889 one acre was planted with two varieties of early potatoes and another with two varieties of late

potatoes. As in the previous experiment, large and small whole potatoes, quarters, and one-eye pieces were planted. One whole tuber or one piece was placed in each hill. The hills were 2 feet apart and the rows 2½ feet apart.

The early varieties were Beauty of Hebron and New Queen; the late varieties were Dandy and Empire State. Severe storms damaged the early potatoes, so that the record for that part of the experiment is incomplete. The actual yields of potatoes in pounds, and the general averages of results computed in bushels per acre, are stated in two tables. The results agree with those recorded in Bulletin No. 2 of the station in showing that the greater the quantity of seed potato planted, the greater the total yield and the yield of merchantable tubers, but it is also indicated that very large seed is not profitable; the most profitable results were obtained where whole tubers of the size of an egg were used. "The smaller the seed used, and the more it is cut, the less the probability of getting a full stand, and when the seed is cut to a single eye this increase of missing hills very materially reduces the crop."

Comparison of seed potatoes from Vermont and Maryland (pp. 56–59).—With a view to learning something of the relative merits of potatoes grown from Southern and Northern seed, the Maryland and Vermont Stations exchanged seed and made duplicate plantings at both places of several varieties which each station had grown in 1888. The yields in both places for each kind of seed of 8 varieties are given in tables, as well as the yields for each kind of seed for 8 additional varieties tried at the Vermont Station. The season was very unfavorable for potatoes in both places. The differences in yield, as shown in tables, favor the seed grown in Vermont.

General notes on vegetables (pp. 60–65).—Brief notes are given on a number of varieties of beans, carrots, cabbages, lettuce, peas, peppers, pumpkins, and squashes, and tabulated notes on 30 varieties of radishes and 11 of turnips.

Orchard and small fruits (p. 66).—Brief mention is made of the growth of the orchard and small fruits planted at the station.

REPORT OF CHEMIST H. J. PATTERSON, B. S. (pp. 67–94).—During 1889, 488 samples were received at the laboratory and filassified as follows: "tomatoes, 356; fertilizing materials, 47; marls, 32; soils, 24; fodders, 22; butters, 3, and miscellaneous, 4. * * * The analyses of most of these samples have been completed, and on all of them some work has been done."

The report contains articles on the following subjects: (1) chemical composition of tomatoes; (2) the effect of fertilizers on the composition of tomatoes; (3) tomato variation and weather changes; (4) comparison of amounts of sugar and acids in the fresh and air-dried substance of the tomato; (5) marls; (6) soils; (7) investigation on the determination of moisture in air-dried feeding stuffs.

The chemical composition of tomatoes (pp. 67–74).—This includes averages of analyses of 63 varieties of tomatoes, giving the percentages of water, ash, sugar, malic acid, and solids soluble in water; methods of analysis used; and the analyses of 6 samples with reference to their food constituents. The percentage of dry matter in the different varieties ranged from 3.10 to 4.52; that of sugar from 1.76 to 3.52; and that of malic acid from 0.5 to 1.74.

Effect of fertilizers on the composition of tomatoes (pp. 74–77).—Samples from three pickings of the Hundred Day and Trophy tomatoes, grown on ten plats fertilized with different materials, and on two unmanured plats were analyzed to study the effects of different fertilizers on the composition of the fruit. The tabulated results show "no marked difference in the composition of tomatoes grown with different fertilizers." The author, however, states certain generalizations, towards which this year's experience seems to point.

Tomato variation and weather changes (pp. 77, 78).—Tabulated data on the meteorological conditions, and the chemical composition of tomatoes, during the ripening season (July 18 to September 2), with brief comments on the table.

Comparison of amounts of sugar and acid in freshly picked and in air-dried tomatoes (pp. 78, 79).—To test the question whether a change takes place in the amounts of sugar and acids during drying, samples were taken of 6 varieties of tomatoes, one half of each sample being examined at once, while the other half was air-dried before examination. From the tabulated statement of results it seems evident that "there is a loss or change of both sugar and acids in the process of drying."

Marls (pp. 79–83).—Descriptions and analyses of 26 samples of Maryland marls.

Soils (pp. 84–87).—Descriptions and analyses of 12 samples of soils sent from or collected in different parts of the State.

Investigations on the determination of moisture in air-dry feeding stuffs (pp. 87–94).—A report of progress in an investigation as to the kind of vessel, length of time, temperature, and medium to be used in moisture determinations; and as to "the nature of the substance lost, and the general change in the process of drying." Details are stated in tables.

REPORT OF AGRICULTURIST, A. I. HAYWARD, B. S. (pp. 95–132).—This includes articles under the following heads: (1) silos and silage; (2) the forage garden; (3) variety test of oats; (4) variety test of wheat; (5) variety test of corn; (6) soil tests with fertilizers and corn; (7) the rotation plats; (8) "seed germinator" tests.

Silos and silage (pp. 95–105).—The silo built at the college in 1888 is described and an account is given of the filling of the silo in 1888, the crop of corn grown for silage in 1889, and analyses of the crops and silage for 1888 and 1889 by the station chemist, together with statements regarding the cost of storing silage.

The silo is a simply-constructed "lean-to," on the north side of the college cattle sheds, 38 feet long and 13 feet wide. Its average height above ground is from 7 to 8 feet, and it is excavated to an equal depth. There are two partitions. This gives three compartments or pits, each 12 feet square inside and about 15 feet deep. The westerly slope of the cattle shed roof is extended to cover all. The sides of the underground part have 8-inch retaining walls of brick. All the rest of the structure is of common rough lumber, except the interior lining of the pits; this is of narrow, matched ceiling pine lumber, dressed and put on vertically, from top to bottom. Every piece of this lining was thoroughly coated with creosote oil before being put in place. The lining covers the interior faces of the brick walls, so that the silage may be in contact with wood, a non-conductor of heat, instead of brick. * * * The three divisions or pits have a storage capacity of a little more than 30 tons each of well-packed silage or over 90 tons in all. The total cost of the silo was $245, or about $2.63 per ton of capacity. This cost might have been reduced at least $100 by omitting the brick walls of the pits and using a cheaper grade of lumber. As built, however, the silo is substantial and will last for years. The experience of two seasons in filling and one in emptying has proved the structure quite satisfactory for its special purpose.

This silo, although easily built and comparatively inexpensive, fulfills the essential requirements for a suitable pit for storing silage. First, it conforms to the existing local conditions; in this case it is an addition or attachment to a set of cheap cattle sheds, rather than an independent structure. Next, it is conveniently arranged, easily filled and emptied. And it has the needed strength to sustain all lateral pressure; it is air-tight, frost-proof, and sufficiently drained. * * * The crops used for silage in 1888, and their maturity, were as follows: A strong-growing, heavy-foliaged, semi-dent white corn, common to the vicinity, the kernels glazed; sorghum, with seed in the dough, the varieties being Chinese and Early Orange cane; and the soja bean, pods formed but seeds not fully developed. [In 1889 the main crop grown for silage was corn. That year it cost $64.40 to harvest and store 45 tons of silage, or $1.43 per ton.] It was estimated that the tangled condition of the corn in the field fully doubled the labor of cutting and loading it, and had the feed cutter been larger, the same engine and fuel could have doubled the quantity cut per day, although another cart would have been needed in hauling. It is easy to see how these improvements might have reduced the cost of storing per ton to about $1. [In a note by the director it is stated that 30 tons and 15 hundred weight of silage were stored at the Houghton Farm in 1883, for $44, or $1.47 per ton.] For purposes of weighting, in 1889, heavy sticks of oak cord-wood were used and found convenient and effective. The experience of this station is in favor of weighting moderately, as with brick in 1888, and fire-wood the next year, both at the rate of 30 to 50 pounds to the surface foot.

The forage garden (pp. 105–119).—A forage garden of about 1 acre was laid out at the station in the spring of 1889, in which grasses and other forage plants are to be tested with reference to their introduction into Maryland. A list of the grasses, clovers, and other forage plants grown at the station in 1889 was printed in Bulletin No. 5 of the station (See Experiment Station Record, Vol. I, p. 75). This article contains brief descriptions of these plants, with notes on their first season's growth. There is also a brief account of an experiment with mixtures of grasses and clovers and of grasses and wheat.

Variety test of oats (pp. 120–123).—A brief general record of the experiment, with tabulated notes on 32 varieties grown in 1889.

Variety test of wheat (pp. 123, 124).—Forty varieties were sown late

in 1888, but owing to unfavorable climatic conditions it was impracticable to secure a fair record of the comparative yields of different varieties. This experiment has been repeated in 1889 with seed obtained from the crop of the previous year.

Variety test of corn (pp. 124–126).—A brief general record of the experiment and tabulated notes on 10 varieties of pop-corn and 12 of dent corn. The crop was much injured by continued wet weather.

Soil tests with fertilizers and corn (pp. 126–130).—The land used for this experiment was nearly level and apparently uniform. "It was divided into plats 1 rod wide by 10 rods long, making one sixteenth of an acre. The twenty-two plats arranged side by side were subdivided across their length, making sections of one thirty-second of an acre. One series, or half of the sections, was planted with the variety Piasa Queen, a yellow dent sent out by the United States Department of Agriculture. The other, with Scott's Improved, a fine white dent variety from the eastern shore of Maryland. These two varieties of corn had the same kind and amount of fertilizers on different sections of the same plat. Plats 1, 2, 3, 4, and 5 of section II were of a different quality of soil and were not included in the test. The plats were check-rowed 3 feet 4 inches apart, giving four rows to a plat and leaving a space of 6 feet between outside rows of contiguous plats." Nitrate of soda, castor pomace, dried fish, Keystone phosphate, Orchilla guano, Mona Island guano, Thomas slag, cotton-seed-hull ashes, sulphate of potash, marl, lime, land plaster, dried blood, dissolved bone-black, and muriate of potash were used singly, and the last four in different combinations. Four plats received no fertilizer. The corn was planted May 30. Germination and growth were uniformly good considering the season, and very little difference could be observed between the plats. The wet weather caused late planting and imperfect cultivation and sufficiently accounts for a generally poor crop.

The amounts of the different fertilizers used and the yields of the several plats are given in a table. The best yield was with dried fish, being at the rate of 39 bushels of shelled corn per acre. Nitrogen alone in nitrate of soda or dried blood gave as good yields as when combined with phosphoric acid and potash.

Rotation plats (pp. 130–132).—A brief account of the first year's results on six plats laid out in 1888, as stated in the First Annual Report of the station, for experiments with various crops in rotation. Each plat is divided into four sections, on which will be compared the effect of rotation of crops without fertilizers and with commercial fertilizers and stable manure alone and in combination.

"*Seed Germinator*" *tests* (p. 132).—A test made at the station with a powder advertised to aid the germination of seeds indicated that it was without value for the purpose.

Report of machinist, E. H. Brinkley (pp. 133–136).—Brief reports on trials of a binder, grain drill, potato digger, transplanter, and three kinds of seed sowers.

METEOROLOGICAL RECORDS (pp. 138–147).—Tabulated data of temperature, rain-fall, and sunshine in 1889.

THE SORGHUM FIELD AND LOSSES IN GROWING WHEAT, H. E. ALVORD, C. E. (pp. 148–156).—A brief account of the growing of sorghum for the United States Department of Agriculture on a field of 10 acres in which 70 varieties were planted.

In view of the oft-repeated statement that "every farm should produce bread for its own people," an effort was made to grow wheat enough on the college farm in 1889 to produce 50 barrels of flour, the amount needed for a year's supply at the college. In connection with this experiment the cost of threshing, selling, and milling wheat were estimated from the experience of the station with this crop. It was found that the cost of threshing was about 11 cents per bushel. The expense of transportation and commission of the middlemen (who were necessarily employed, since the miller refused to take the wheat directly from the producer) amounted to about 9 cents. The wheat thus sold should have made 50 barrels of flour and paid the expenses of milling, but with the net proceeds of the wheat the station could buy only 27¾ barrels of flour even at wholesale rates. According to the rules of business in force in Maryland the farmer is compelled to "produce wheat enough for 2 barrels of flour in order to provide his family with one."

Massachusetts State Station, Circular, November, 1890 (pp. 4).

ANALYSES OF COMMERCIAL FERTILIZERS AND OF MANURIAL SUBSTANCES SENT ON FOR EXAMINATION.—This includes analyses of wood ashes, "fish chum" and 18 samples of commercial fertilizers, made in connection with the execution of the Massachusetts fertilizer law.

Massachusetts Hatch Station, Meteorological Bulletin No. 23, November, 1890 (pp. 4).

A daily and monthly summary of observations for November, 1890, made at the meteorological observatory of the station, in charge of C. D. Warner, B. S.

Michigan Station, Bulletin No. 67, October, 1890 (pp. 32).

FRUIT TESTING AT THE SOUTH HAVEN SUBSTATION, T. T. LYON.—An introduction by L. R. Taft, M. S., horticulturist of the station, says: "In the spring of 1888 the board of agriculture authorized an arrangement with T. T. Lyon by which the station secured a report upon the fruits growing on his extensive experimental plantation at South Haven. The report was issued as Bulletin No. 55 [See Experiment Station Record, Vol. I, p. 228], and was so well received that at the urgent solicitation of the fruit growers of the 'fruit belt' it was determined to place the work on a more permanent basis. The people of South Haven do-

nated a tract of land adjoining that of President Lyon, and future plantings of trial fruits will be made on it. As some time must elapse before results can be obtained from the station trees, the use of the Lyon tract was secured, and from the plants growing thereon the following report was prepared by President Lyon, whose services we were fortunate enough to secure to carry on the work."

Strawberries.—Tabulated data for the season of 1890 are given for 91 varieties, with descriptive notes on 36 of the most productive varieties. For the test of 1891, 148 varieties were planted last May, one half of the plants of each variety being grown in hills and the other half in matted rows.

Raspberries.—Tabulated data are given for 21 varieties of *Rubus idæus* and *R. strigosus* and supposed hybrids from these, propagating by suckers, with descriptive notes on 11 of the most prominent varieties; and for 21 varieties of *Rubus occidentalis* and supposed hybrids, rooting from the tips of the canes, with descriptive notes on 13 of the more valuable varieties. In the first set the following varieties are recommended for family use or for market: "Thompson, Turner, Herstine, Golden Queen, Cuthbert; with high culture and careful winter protection, improved quality may be secured by adding the Brinckle. * * * Among blackcaps of established reputation a valuable selection for a family garden would be Souhegan, Tyler, or Doolittle for early, followed by Hilborn (the genuine) and Nemaha with Shaffer for canning. For a market list Gregg may be substituted for Hilborn."

Blackberries and dew-berries.—Tabulated data are given for 21 varieties of blackberries and 2 of dew-berries, with descriptive notes on 13 of the more desirable varieties. "A good succession for a family plantation is Lucretia (dew-berry), Early Harvest, Kittatinny (with winter protection), Snyder, Taylor. For market, Early Harvest, Wilson or Wilson jr. (with winter protection), Snyder, Taylor."

Currants.—Tabulated data are given for 20 varieties. "The variation among currants is comparatively slight, whether as to quality, size, or productiveness. The following varieties, which are briefly described, are recommended for home use: White Dutch, Red Dutch, Victoria, and Lee. For commercial plantations, "Cherry Versaillaise or Fay will, either of them, yield good returns of large-sized, attractive looking fruit, with possibly slight, undetermined differences of yield. As in the case of home plantations, the Victoria, on account of its comparative exemption from the depredations of the borer, will be found more profitable in infested localities." Wide differences have been found in the results from plants disseminated under the name of Crandall, and the value of this variety is yet undetermined.

Gooseberries.—Tabulated data are given for 12 varieties. Houghton, Smith, and Downing are briefly described and are recommended for family or market purposes. "Industry is an imported variety of *Rubus*

grossularia, which has been considerably disseminated, as being less liable to mildew than others of its species, but several seasons' experience with it at this place fail to warrant such claim."

Cherries.—"Of this fruit the Mazzard varieties succeed so imperfectly in Michigan that only a comparatively limited number of these varieties have been planted. Selections for this purpose have been more largely made of Dukes and Morellos, among them being several of the comparatively recent and supposed hardy varieties imported by Professor J. L. Budd, of Iowa, from Northeastern Europe, several of which are apparently identical in habit of growth with the Morellos. Others are designated as belonging to families, among which are Griottes, Ostheims, and others rarely planted in this country; some of them correspond in habit of growth with the Morellos, while others show the Duke habit, or are possibly intermediate in this particular." Forty-three varieties of cherries are now growing at this substation, of which a considerable number were planted in the spring of 1890. Tabulated data are given for 22 varieties, with brief descriptive notes on 15 of the more valuable varieties.

Mulberries.—"Although the mulberry is indigenous in Michigan, it has rarely been planted for economical purposes until within recent years." Downing, Hicks, New American, Russian, and Teas's Weeping, are varieties on trial at this substation.

Service or June-berries.—Two dwarf varieties, Common Dwarf and Success, are on trial and are briefly described.

Peaches.—Thirty-seven varieties were planted in 1888, and sixty-five in 1890.

Grapes.—Forty-three varieties were planted in 1888, 43 in 1889, and 40 in 1890. Tabulated data are given for 39 varieties yielding fruit in 1890.

From the experience and observation of this as well as of previous years, the following lists are suggested for the consideration of planters of this fruit. To those who prize high quality, even with the penalty of somewhat diminished returns, and are willing to devote the needful care and labor, the following may be expected to yield satisfactory results: Jessica, Lady, Early Victor, Delaware, Brighton, and Empire State; and on suitable soils, and when the season will suffice to mature them, Iona and Excelsior. For planters who require varieties which will mainly "take care of themselves" and still yield at least some returns, even though of lower quality: Lady, Moore's Early, Worden, Hayes, and Niagara, with Isabella when the season will suffice to ripen it. For the market grower who wishes to work for customers who value quality and are able and willing to pay for it: Early Victor, Delaware, Brighton, Ulster. For growers for average city or village customers who generally "buy by the eye": Moore's Early, Worden, Concord, Niagara.

Plums.—Seventeen varieties were planted in 1888, and 59 in 1889, including 35 varieties of *Prunus domestica* (the garden or European species), 18 of *P. americana* (the native wild plum of the North), 7 of *P. chicasa* (the native plum of the Southwest), 15 of the recently introduced Japanese species, and Pissard (an alleged variety of the cherry plum).

So large and varied a collection has been gathered, with the purpose to supply the means of observing their comparative ability to resist the various maladies to which, in our climate, both tree and fruit have proved liable, with the hope to discover among them varieties, or possibly species, adapted to profitable cultivation here, where the cultivation of this fruit has for many years been practically abandoned. Another, though incidental, object has been to provide a collection upon which the varying results of the use of insecticides and fungicides, as well as other appliances, upon the several species and varieties can be satisfactorily observed and compared.

Pears.—Twenty-four varieties were planted in 1888, 12 in 1889, and 14 in 1890.

Planters desiring a succession of this fruit of high quality, and willing to secure it by means of intelligent and careful treatment, will find the following list of varieties adapted to such purpose. The varieties are named, as nearly as practicable, in the order of their ripening: Summer Doyenne, Giffard, Bloodgood, Tyson, Rostiezer, Clapp's Favorite, Howell, Bosc, Anjou, Winter Nelis, and Dana's Hovey; and Pound, if a variety is desired especially for culinary uses.

For the average of small planters the following will afford a partial succession of vigorous and productive varieties of fair quality: Summer Doyenne, Clapp's Favorite, Bartlett, Sheldon, Howell, Onondaga, Anjou, Lawrence.

Market list, affording a succession: Summer Doyenne, Tyson, Sterling, Clapp's Favorite, Bartlett, Howell, Onondaga, Bosc, Anjou, Lawrence.

Apples.—Fifty-six varieties were planted in 1888, 4 in 1889, and 54 in 1890.

Quinces.—Four varieties were planted in 1888 and 3 in 1890.

Chestnuts.—The following varieties have been planted: Hathaway, Japan, Japan Sweet, Paragon, and Spanish.

Walnuts.—The Madeira, Præparturiens (a dwarf variety), and Japan have been planted.

Seedling pecan plants and seed of the chinquapin have also been planted.

Asparagus and rhubarb.—Six alleged varieties of the former and 6 varieties of the latter have been planted.

Michigan Station, Bulletin No. 68, October, 1890 (pp. 17).

THE JACK-PINE PLAINS; SILAGE; MILK AND FERTILIZER ANALYSES, R. C. KEDZIE, M. D.—This bulletin contains the annual report of the chemical department of the station.

Commercial fertilizers.—The chemical department of the station has been charged by the State board of agriculture with the duty of making the analyses of commercial fertilizers required by the State law.

In carrying out the provisions of this law, and compelling all manufacturers and dealers to comply with its provisions, something has been accomplished toward excluding from the markets or stopping the sale of fertilizers of little commercial value. The quality of some commercial fertilizers has been raised. In both these ways the farmer has been benefited, and the State saved from loss.

In the inspection and licensing of these fertilizers, no guarantee is given of the value of any of them. The manufacturer makes his own standard, and the station only seeks to make him keep his goods up to his own standard. The license does not warrant the quality of the fertilizer, but shows that the manufacturer has paid his

license fee, deposited a sample of his goods made,and a sworn statement of the composition of the same with regard to the three most valuable elements in manures. The results of the analyses made in 1890 are reported in Bulletin No. 64 of this station [See Experiment Station Record, Vol. II, p. 237]

The jack-pine plains.—The experiments on the sandy soils of these plains, to which reference has been made in the Annual Report of the station for 1888 (See Experiment Station Bulletin No. 2, p. 94), and Bulletin No. 54 (See Experiment Station Record, Vol. I, p. 228) have been continued in 1890. This report contains an account of those made at the experimental farm at Grayling. Lists are given of the crops grown in rotation during the past 3 years on the different experimental plats.

The only manures used in these experiments (with the exception of sugar-beets) were marl, gypsum, and common salt. The effort has been made to enrich these soils by green manuring—the plowing under of the crops raised on these lands—with the aid of cheap fertilizers, which any person could obtain without any large outlay. To unlock the reserve materials in the soil and bring them into active service, and to draw upon the atmospheric supplies of plant food, have been prime objects sought in these experiments. At the same time cheap forms of mineral food for plants have been brought into use. The marl has produced marked benefits wherever used. The gypsum has also been beneficial in most cases, while salt has shown little or no benefit.

Cut-worms, the flea beetle, and other insects did considerable damage. The experience of 1890 tends to modify the opinions expressed in the report of 1889 regarding various plants used in these experiments. Alfalfa was badly winter-killed, and buckwheat and Bokhara clover have been discarded. Spurry, vetch, field peas, and red, alsike and white clover have given results which are promising.

Spurry still holds its high rank, and the crop is rapidly spreading in this region. With many farmers it yields a large amount of forage, and they find it a profitable crop to feed stock. The wonderful seed production gives it a good foothold in soils when once sown. The introduction of this crop is a permanent benefit to the jack-pine belt. * * *

Field peas are full of promise. The ability to withstand frost, to take up large supplies of food from the atmosphere, and to penetrate the soil deeply by its far-reaching roots, fit it for growth on these Northern plains. After a crop of vetches or spurry a good crop was secured. A plat of peas on the south field was plowed under and the ground sowed to clover and timothy, giving the most promising plat of meadow sward on the field. A plat of peas in the north field was plowed under and the ground sowed with a mixture of timothy and redtop, from which good results are hoped for.

Of the grasses, timothy by itself does not form a smooth and satisfactory sward. Combined with other grasses better results may be secured. The usual combination of timothy and clover has given a promising sward on two plats. The combination of timothy and redtop is now on trial. The perennial rye grass and tall meadow oat grass appear to form a better sward than any single grasses. The tall fescue is valuable. * * *

[Five varieties of sugar-beets were grown. The crop was poorly managed and the beets were small. The percentages of sugar as determined by analyses were relatively high, ranging from 14 7 to 16.6.]

The changes in the soil as the result of three years cultivation are manifest to every observer. In place of the open and porous soil, in which the foot would sink as in an ash heap, a firm seed bed has been secured; the color of the soil has perceptibly

changed with the increase of vegetable mold by plowing under successive crops, and the power to retain moisture is greater. Whether its capillary power is increased and the ability to draw upon the permanent store of ground water found in the soil at the water level remains to be determined. It is probable that suitable cultivation and care of the soil may increase its power to withstand drought, both by increasing its ability to hold the water that comes in the rain, and by augmenting capillarity, enable it to draw upon the ground water. Some investigations on soil physics, especially as related to soil water, are already planned for the coming season.

Conclusions.—(1) The problem of the plains is a complex one, involving considerations of climate, as well as constitution of soil.

(2) The problem is not yet solved.

(3) It is worthy of further efforts at its solution—patient, conscientious, and thorough work to find the truth.

Silage vs. dry fodder, from corn cut at different periods of growth.—"In order to determine quantitative results in the silo, and the value of silage made from corn stalks at different periods of growth, as well as the relative value of stalks and silage at the same period of growth, the investigation reported in this bulletin was carried on in August and September, 1889, and extended into the winter of 1890." Hathaway, a variety of dent corn, was grown on the college farm in 1889.

The first cutting was August 10, when the corn was fully tasseled, the ears had set, and the silk was appearing on the ears. The subsequent cuttings were made at intervals of about a week, the last cutting September 14th, when the corn was ripe.

Two square rods were measured off for each cutting, the stalks immediately weighed, cut into half-inch lengths by a feed cutter, a part placed in an oak cask used for a silo, a tight-fitting head placed on the top and forced down by a strong screw and securely fastened; the balance rapidly dried by steam heat and reserved for analysis. Knowing the weight of the stalks for a given area at the time of cutting, and finding the per cent of dry matter at each cutting, it was easy to calculate the amount of dry matter to the acre at each cutting.

The seven casks of silage were kept in a cool cellar till February, 1890, when the amount of dry matter was determined and a complete analysis made of the silage. A considerable amount of water was poured off from the top of cask No. 1 a short time after the material was placed in the cask, and a less amount from cask No. 2. Some anomalies exhibited in the analysis of the silage, particularly in regard to the amount of ash, may be explained by the disturbing influence of the juice poured off.

A table gives for each cutting the amount of green and dry matter in the corn before ensiling, the per cent of free acid and amount of dry matter in the silage, and notes on the condition of the corn at the time of cutting and on the weather.

From this table it appears that while the weight of green stalks does not vary widely, the amount of dry matter increases steadily from 2,672 pounds per acre August 10, to 4,536 pounds September 14, nearly doubling in five weeks. * * * The percentage of dry matter in the silage steadily increases from the first cutting, 10 per cent August 10, to nearly 30 per cent September 14.

The estimated amount of dry matter in the silage from 1 acre shows a steady increase from 1,920 pounds to 4,411 pounds; the loss of dry matter by ensiling passes from 752 pounds per acre to 125 pounds. The amount of acid falls from 1.26 per cent in No. 1 to 0.70 per cent in No. 7—a decrease of nearly one half. This shows clearly the loss occasioned by using succulent and immature corn for silage, and the advantage of using corn that is nearly ripe. [Another table gives the results of chemical analysis of the corn before ensiling and of the silage, for each cutting.]

The ash in corn and in the silage shows a steady decrease with the increased age of the plant, as we would naturally expect. The crude fiber is quite uniform in the corn stalks, but in the silage there is a steady decrease from 29.41 per cent to 22.98, showing that with the ripened stalks in the silo a larger amount of the crude fiber is made digestible and assimilable by the animal. The ether extract is increased nearly 75 per cent in the silo. * * * The changes in the per cent of nitrogen-free extract seem small. But when we take into account the large increase of solid matter as growth proceeds we see the significance of these changes. Thus the 49.04 per cent of the nitrogen-free matter in the first cutting of corn represents only 1,310 pounds to the acre, while the 57.02 at the last cutting represents 2,576 pounds; in the silo the 45.68 per cent of the nitrogen-free matter of the first cutting represents only 876 pounds, while the 58.65 per cent of the seventh cutting represents 2,587 pounds of carbohydrates.

In the nitrogenous constituents there is a falling off in the per cent, but an actual increase for the whole product. Thus the 11.43 per cent of albumen in the first cutting of the corn represents only 295 pounds of albumen per acre, while the 8.62 per cent of the seventh cutting represents 391 pounds per acre. In the silage there are 125 pounds of albumen per acre in the first cutting, and 322 pounds in the seventh cutting. There is an apparent loss of albumen in the silo, a portion being converted into amides, which are inferior to the albuminoids in feeding value.

Analyses of milk of different breeds.—In the spring of 1890 an experiment was begun at the station to test the milk-producing qualities of different breeds.

The plan required the use of two young cows from each of four representative breeds, of the same age, and whose pedigree and method of feeding were well known; the cows during the time of experiment to be fed according to a definite plan, and a record kept of the kind and quantity of food consumed; a daily record of the amount of milk given by each cow; a careful chemical analysis of the milk from each cow two or three times a week; churning the milk from each cow two or three times a week to determine the churnability of the milk, to estimate the amount and quality of the butter made; the analysis of this butter and of the buttermilk to determine the completeness with which churning will separate the milk fats by comparison with the fats found in the whole milk—thus affording the data for determining the relative value of representative breeds for the dairy and cheese factory.

It seemed to these departments that such an investigation carried through an entire season, with two cows of each breed to "eliminate the personal equation," when the history of the cows was known and their food made a matter of record, would afford a basis for a safe estimate of the relative value of these breeds as milk producers. Only three pairs of cows furnished milk for this investigation and these did not all come to milk at the same time.

The plan proposed was only partially carried out and the experiment was discontinued August 22. The method of gathering samples of milk for analysis and the method of analysis used are described. The results of analyses of milk made at different dates from April 16 to August 22 are stated in detail and summarized in tables. The average composition of the milk of the two cows of each breed is given as follows:

	Jerseys.	Ayrshires.	Holsteins.
	Per cent.	*Per cent.*	*Per cent.*
Total solids	13.85	12.04	11.22
Butter fat	5.51	3.68	3.33
Solids not fat	8.53	8.35	7.89
Water	86.15	87.96	88.78

A Michigan law declares that milk containing "less than 12½ per cent of solids or less than 3 per cent of fat shall be deemed adulterated." Both the Ayrshire and Holstein milk fell below the required standard as regards amount of total solids, though above the standard so far as fat is concerned.

Michigan Station, Bulletin No. 69, November, 1890 (pp. 15).

FEEDING STEERS OF DIFFERENT BREEDS, E. DAVENPORT, M. S.—The experiment here reported is similar to one reported in Bulletin No. 44 of this station (See Experiment Station Record, Vol. I, p. 84). The object of both of these experiments was to determine, as far as possible, "whether or not, properly speaking, there are such things as breed differences, aside from form, color, etc., and if so, what are their character and extent? Are they sufficient to distinguish one breed above another?"

As nearly typical specimens as it was possible to secure of five breeds—Galloway, Holstein, Hereford, Shorthorn, and Devon—were used. The animals "were all purely bred, and were such as were furnished by breeders of the several breeds." There were originally two of each breed, but owing to accidental circumstances one Shorthorn and one Devon were dropped. The feeding stuffs were at all times the same for all the animals, but the amount fed was regulated by the individual appetites. The grain consisted of corn and oats (either whole or ground), bran, and "oil meal;" the coarse fodder was mostly mixed hay (timothy and clover), with roots, corn silage, cut grass, fodder corn, and some pasturage. "The influence of different kinds of feeding stuffs has not entered into this experiment." The record of the feeding extends from March 10, 1889, to September 5, 1890, eighteen months. "All of the animals fed well and were healthy and vigorous during the entire experiment." They were all slaughtered at the end of the trial. Tables record for each animal the amounts of each kind of feed consumed, gain in live weight by months, and the dressed weight, shrinkage, weights of fore and hind quarters, hide, tallow, intestines and paunch, head, feet, tail, liver, lungs and heart when slaughtered. Some of the more important data are summarized in the following statement:

Amounts of feed consumed per animal, live and dressed weights, and weights of parts.

Animals.	Age at beginning of experiment.	Live weight.	Total gain in live weight.	Feed.				Dressed weight.	Loss in weight by dressing.	Weight of—				
				Grain.	Hay.	Roots.	Silage.			Fore quarter (shrunken.)	Hind quarter (shrunken.)	Hide.	Tallow.	Intestines and paunch.
Galloway:	*Days.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*P. ct.*	*Lbs.*	*Lbs.*	*Lbs*	*Lbs*	*Lbs.*
Jumbo	334	650	674	4, 157. 0	2, 298	1, 379	2, 841	797	36. 24	414	367	90	119	100
Colby	347	840	870	5, 293. 0	2, 848	1, 774	3, 261	996	36. 96	523	454	126	125	153
Holstein:														
Walton	405	870	790	5, 530. 0	3, 214	1, 775	3, 427	973	36. 82	493	456	97	154	159
Nick	367	740	897	5, 657. 0	3, 144	1, 775	3, 344	985	35. 62	507	459	97	116	153
Hereford:														
Milton	449	920	790	5, 120. 0	3, 028	1, 775	3, 151	1, 073	32. 52	563	492	110	117	140
Boy	259	485	905	4, 134. 5	2, 191	1, 255	2, 853	842	36. 70	441	386	99	98	127
Shorthorn:														
Barrington	242	605	1, 005	4, 964. 0	2, 763	1, 672	3, 329	971	33. 95	523	432	93	97	159
Devon:														
Disco	174	440	767	3, 740. 5	1, 898	1, 074	2, 553	712	37. 50	379	320	80	87	133

The cost of feed for each animal is not calculated. The reports of several persons who tested the meat were unanimous in ascribing the best flavor to that of the Devon, which was the youngest animal of all, that of the Galloway, Holstein, Hereford, and Shorthorn following in the order named.

The results of this experiment seem strongly to confirm the following:

(1) The amount of food consumed is no index of the amount of gain it will produce, that is, of its profitable use and conversion into meat.

(2) Neither is the total gain secured, nor the rate of gain a sure guide to the economical use of food by the animal.

(3) Large gains are not necessarily economical ones nor medium ones necessarily costly.

(4) Age is the all-controlling circumstance that decides the rate of gain. The ration necessary to sustain the gain increases with age in about the same proportion as the weight of the animal, but the gain remains absolutely about the same.

(5) "Baby beef" is not inconsistent with high quality.

(6) Nervousness is not necessarily a sign of a bad feeder.

(7) Great development in size is not a necessary condition to profitable feeding nor to quality.

(8) The "type" of an animal has much to do with his ability to use food to good advantage in the production of meat. In this sense there is a distinction and a difference between the breeds for beef purposes.

(9) Those nearest the "dairy type" made less gain to the food consumed, and it consisted more largely of fat on and about the internal organs. This type was also characterized by coarser extremities, a longer, fatter rib, more shrinkage of meat in cooling, and a higher percentage of cheap parts.

The author further adds that—

As between the beef breeds, I think no one can here suggest marked differences that can not be sufficiently explained on other grounds. As in all experiments of this kind, greater differences are noticeable within the breeds than between them. The two Herefords are in this experiment nearly at extremes in everything but type, and in that respect as far apart as is allowable among Herefords. Aside from the Holsteins, no two animals of the lot differed more than did the two Herefords. Very close upon them came the two Galloways, with marked differences in build.

Knowing these animals as I did, I think I may safely say that as they, irrespective of breed, approached a certain stocky, blocky form, that we designate as the "meat type," in the same degree they proved good feeders and economical consumers of food within a reasonable age. On the other hand, as they approached the coarser or more loosely built organization, * * * in about the same proportions were they less profitable consumers of food for meat purposes and turned out a less desirable carcass for the block. If this be true, as I believe it is, it is a question of type rather than of breed, and that breed that affords the largest proportion in members of this type is, all things considered, the best.

Mississippi Station, Bulletin No. 13, September 25, 1890 (pp. 8).

FEEDING FOR MILK AND BUTTER, E. R. LLOYD, M. S.—"On November 24, 1889, sixty cows were put into the station barn for the purpose of making a series of tests to determine the most economical food for the production of milk and butter. The herd was divided into six lots containing ten cows each, of which seven were common 'natives' purchased in the immediate neighborhood, two were low-grade Jerseys, and one a grade Devon belonging to the college." Of the six lots, two were fed cotton seed, two cotton-seed meal, and two corn meal; the coarse fodders for each two lots receiving the same grain, being in the one case Bermuda hay, and in the other "mixed hay" consisting of about three-fourths Japan clover (*Lespedeza striata*). "For some time previous to beginning the tests the cows had been kept in an ordinary pasture, and each had been fed 5 pounds of cotton-seed meal daily."

The trial lasted for twelve weeks. During this time each cow had all the hay she would eat (about 10 pounds daily) and the following grain rations per cow daily: lots 1 and 2, 12 pounds of cotton seed, though "it was found that few of them would eat so much;" lots 3 and 4, 7 to 10 pounds of cotton-seed meal, and lots 5 and 6, 10 pounds of corn meal.

The food for each lot was weighed separately morning and evening, and all waste reweighed in the morning; and the cows charged with the amount actually eaten.

The milk from each cow was weighed separately at each milking, and samples of the milk were taken for testing on Wednesday morning and evening of each week. In taking these samples the milk of each lot was thoroughly mixed, and 1 liter (about a quart) taken for the test. These samples were kept at a temperature of 65° Fah. until ripened, when they were churned and the total butter yield estimated from the yields of the samples.

In estimating the cost of the milk and butter produced the "mixed hay" was valued at $7 per ton, Bermuda hay at $10, cotton seed at $9, cotton-seed meal at $20, and corn meal at $20.85, and no account was taken of the value of the manure. The first week was regarded as a preliminary period. The results of the butter tests made in the seventh week are believed to be incorrect and are not included in the record of the trial. The detailed results of the trial are tabulated.

The following statement summarizes those for the ten weeks, for which the data are complete, the grain rations stated being the averages of

the amounts fed to each cow of the several lots, per day, during the whole experiment.

Amount of milk and butter produced, and cost of feed per pound of butter.

Feed.	Cost of feed consumed per lot.	Amount of milk produced per lot.	Amount of morning's milk required to produce 1 pound of butter.	Amount of evening's milk required to produce 1 pound of butter.	Butter.	
					Amount produced per lot.	Cost per pound.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*
Lot 1, 8.6 pounds cotton seed and Bermuda hay	$56.45	5,773.4	18.1	13.5	359.46	15.70
Lot 2, 9 8 pounds cotton seed and mixed hay	52.01	5,519.5	18.2	13.8	339.46	15.62
Lot 3, 9.7 pounds cotton-seed meal and Bermuda hay	112.32	7,597.4	20.3	15.2	418.50	26.83
Lot 4, 9.9 pounds cotton-seed meal and mixed hay	99.30	6,940.0	18.7	14 1	419.98	23.62
Lot 5, 9.9 pounds corn meal and Bermuda hay	110.66	6,161.2	22.5	19.1	297.66	37.31
Lot 6, 9.7 pounds corn meal and mixed hay	94.71	5,814.9	24.2	18.3	280.20	33.65

"From the work so far accomplished it appears:

"(1) That for the production of milk a ration composed of Lespedeza [Japan clover] hay and cotton seed is the most economical.

"(2) That cotton seed is more economical than cotton-seed meal as a grain ration.

"(3) That Lespedeza [Japan clover] hay is more economical than Bermuda hay.

"(4) That corn meal is too expensive for use in this State.

"(5) That the ration which will produce milk at the least cost is also the most economical ration for butter, if no consideration be given to the quality of the latter."

EFFECT OF TIME OF MILKING AND NUMBER OF HOURS BETWEEN MILKINGS ON THE BUTTER CONTENT OF MILK, E. R. LLOYD, M. S.—"A very constant difference was observed in the butter content of the milk from the morning and evening milkings. * * * In a further study of this matter two cows were used during August and September, 1890, in making a series of special tests of the effect of time of day of milkings and number of hours between milkings. During the first week they were milked at 7 a. m. and at 6 p. m., during the second week at 6 a. m. and 7 p. m., and during the third week at 6 a. m. and 6 p. m. * * * Although the results show considerable irregularity, they seem to indicate that day and night influence the amount of butter fat much more than does the number of hours between milkings."

Missouri Station, Bulletin No. 12, June, 1890 (pp. 16).

BLACKLEG, P. PAQUIN, M. D., V. S. (illustrated).—This disease is stated to be the cause of the death of many thousand calves and young cattle in Missouri every year, though the total annual losses

are not known. It is described as a disease due to parasitic bacteria (or germs), which exist in certain localities, particularly in low or rich grass lands. These organisms when introduced into the bodies of young cattle grow principally in the connective tissue (between the skin and the flesh) and in the muscles, causing dark, bloody, gaseous tumors. Other characteristic symptoms of the disease are fever and lameness. The duration of the disease varies from a few hours to a few days, making medicinal treatment difficult even if curative remedies were known. The disease may, however, be prevented by inoculation with the modified virus of blackleg, according to the method discovered by Arloing, Thomas, and Cornevin, and extensively practiced in Europe.

It is advised to have the animal inoculated twice, allowing about a week to elapse between the operations. During an outbreak of the disease only the animals showing signs of the disease should be inoculated. On farms where blackleg occurs more or less regularly all young animals should be inoculated at five or six months of age.

The bulletin also makes suggestions as to treatment where the disease breaks out unexpectedly in new places. Experiments in transmitting the malady to cattle, sheep, and rabbits by direct inoculation of the germs, are described in detail. The differences between blackleg and charbon (anthrax) are stated and illustrated by figures of the germs of both diseases. The bulletin also contains a tabular summary of tests made by the station in 1889 in which eighty-two head of cattle were inoculated. Only one of these animals died and that one was suffering from blackleg when inoculated.

New York State Station, Bulletin No. 23 (New Series), September, 1890 (pp.29).

COMPARATIVE TEST OF COWS, P. COLLIER, PH. D. (pp. 297–323).—This contains tabulated data on a trial with four cows made to "test their relative merits as milk and butter producers under like conditions;" a short trial with two cows to compare the effects of feeding dry feed, and the same moistened; and the milk record of two cows during two weeks on a ration consisting of corn stover, sugar-beets, and grain. The trials were not conclusive, and were of such a nature as to allow of no deductions of general interest.

LOSS IN KEEPING MANURE, P. COLLIER, PH. D. (pp. 323–325).—To observe the loss which takes place in the amount of fertilizing ingredients by weathering, one half cord of fresh manure from a cow stable and one half cord of "old compost, of which muck was the leading ingredient," were each weighed, sampled for analysis, and piled separately in close, conical heaps, January 4, 1889. "The season of 1889 in this locality was exceptionally cloudy and wet. * * Both piles were reweighed April 13, returned to the same place, and carefully piled as

before. This was equal to a complete forking over, the piles having been handled twice with a fork in the operation." January 21, 1890, both piles were weighed, measured, and samples analyzed. The manure had lost, during the year, about 65 per cent and the compost about 30 per cent of its weight. Analyses of both the manure and the compost at the beginning and end of the year are given, together with a calculation of the total amounts of valuable fertilizing ingredients in the same.

"These figures show a loss from the weathering in every particular except the phosphoric acid, of which a somewhat larger amount was obtained from the later analysis, but the apparent gain is so small that it could easily have occurred within duplicate determinations on so small an amount."

Allowing 17 cents per pound for nitrogen, 4 cents for potash, and 7 cents for phosphoric acid, the loss amounted to $1.25 for one half cord of manure, and 59 cents for one half cord of the compost.

New York State Station, Bulletin No. 24 (New Series), October, 1890 (pp. 20).

EXPERIMENTS WITH STRAWBERRIES (pp. 327–346, illustrated).—In view of the relatively large yield of strawberries and their profitableness, the farmers of New York are advised to give more attention to their production. Brief directions for the cultivation of strawberries are given in this article.

There has been considerable work done at this station within the past 3 years in crossing varieties and making fruit selections. Of 1,000 seedlings fruited in the seasons of 1888 and 1889, but 20 were saved as showing any indication of being of value. Of these 20, 15 have been discarded this season. Of 700 seedlings fruiting this year for the first time, less than 50 have been noted as good enough to give one more year's trial. This shows how very seldom it is that seedlings, even when crosses, give results commensurate with the time and bother of raising them. This last winter there has been a large amount of work done in the greenhouse in the way of systematic crossing of varieties, or, in other words, breeding for a purpose. When the pollenized plants perfected their fruits many of them gave fruits so utterly unlike the fruits of either of the parents that, with the special idea of studying the potency of the pollen of different varieties, drawings of several were made, some of which are incorporated in this bulletin. So much has been said against the theory of the influence of pollen showing on the first fruits that the pollenized plants bear that these plates will be of interest to those who are endeavoring to solve this question.

The 8 crossed varieties illustrated in plates are briefly described. Brief descriptive notes are also given for 103 varieties of strawberries grown at the station, with a list of the 20 most productive varieties grown in matted and in stool rows. The dates of first bloom and first ripe fruit and the length of the picking season are stated for 15 early and 15 late varieties. The extent of the injury by leaf blight as observed during five years (1886–90) is given for 77 varieties. There are

also brief descriptive notes for the season of 1890 on 44 varieties grown at Pulaski, New York, and on 11 varieties grown at Rochester, New York.

New York State Station, Bulletin No. 25 (New Series), November, 1890 (pp. 39).

THE NEW YORK STATE FERTILIZER CONTROL AND FERTILIZER ANALYSES.—"This is the first of a series of bulletins treating of fertilizers, to be issued by the station for the benefit of the farmers of New York State." This number, which "is intended mainly as an introduction to the series," contains a statement of the plan of proposed fertilizer bulletins, the text and object of the New York fertilizer law, information regarding the organization of the work, method of sampling and laboratory methods, and analyses of 29 samples of commercial fertilizers collected by agents of the station during the fall of 1890.

New York Cornell Station, Bulletin No. 21, October, 1890 (pp. 12).

NOTES ON TOMATOES, L. H. BAILEY, M. S., AND W. M. MUNSON, B. S. (pp. 75–86, illustrated).—This includes brief reports on experiments with reference to the effects of breeding, heavy fertilizing, early and late setting, seeds *vs.* cuttings, trimming, and double flowers as producing irregular fruits, together with notes on the yield of tomatoes in 1890 and on varieties tested at the station.

Effects of breeding.—The value of careful and systematic selection of stock has been clearly shown in the experiments with tomatoes conducted for five years at the station. "Unusual care was exercised in the selection of stock seed in 1889, and in the case of the Ignotum careful breeding has been practiced for several seasons. Our whole trial ground may be said to have been planted with pedigree seed this year, for the stock was obtained from our own selections of 1889, from special stock contributed by the introducers of standard varieties and from the originators of the new and untried sorts. As a result our plantation was the most uniform which we have ever seen, with remarkably regular and handsome fruits."

In making selections greater value has invariably been attached to the character of the stock plant than to individual fruits. For example, two lots of Volunteer tomatoes were grown this year under like conditions. One lot was from commercial seeds and the other from seeds of a small and inferior fruit taken from a plant having mostly large fruits. The first lot yielded 6.7 pounds per plant, with an average weight per fruit of 5.3 ounces; the second lot yielded 8.8 pounds per plant, with an average weight per fruit of 7.3 ounces. Similar results were obtained with the Mikado.

Effect of heavy fertilizing.—The experiments of last year, reported in Bulletin No. 10 of the station (See Experiment Station Record, Vol. I, p. 276), "show that the common notion that heavy manuring lea-

sens productiveness of the tomato is open to doubt. Excessively manured soil gave nearly twice heavier yields than unfertilized soil, and a third heavier than nitrate of soda treatment. The test was repeated this year upon the same areas." Muriate of potash, nitrate of soda, stable manure in excessive quantities on rich garden soil, and stable manure liberally applied to ordinary garden loam, were compared with each other and with no manure. The results with the stable manure were very much the best and confirmed those of last year.

It is extremely doubtful, however, if this very heavy manuring pays its cost, especially in gross productiveness; but it is worth while to observe that the individual fruits on the heavily manured plats averaged more than a half heavier than those on liberally manured garden soil. If tomatoes are profitable in proportion to their size and weight it would appear that the heavy manuring in this case might be commercially profitable. The results obtained with liberal manuring under commercial conditions, as compared with the figures obtained from no fertilizing and from nitrate and potash treatments, certainly show that good stable manure in abundance can be used profitably.

The application of stable manure in large quantity to clay land did not secure a profitable crop. This, however, is not attributed to the manure but to the unfitness of such land for tomatoes.

Early and late setting.—"Trials last year showed that early sowing in the North results in increased profitable productiveness." This year the comparative value of early and late setting out of doors has been tested with two lots of Ignotum plants. One lot was set out of doors May 9 during a cold rain, which was followed by cold and dark weather for several days. For about three weeks the plants made no growth. The other lot was set out June 12, when the weather was warm and settled. "The first ripe fruit was picked from each row the same day, August 5. But the late-set plants did not come into full bearing until a month later, while the others bore steadily from the first picking." One hundred and forty pounds of fruit were obtained from twelve of the early-set plants and only 30 pounds from the same number of late-set plants.

Seeds vs. cuttings.—"It is frequently said that plants grown from cuttings are superior in earliness and sometimes in productiveness to those grown from seeds, and some growers carry over a few stock plants of tomatoes in a greenhouse or conservatory for the purpose of securing spring cuttings." The results from cuttings of Ignotum, Lorillard, and Sunrise tomatoes, as compared with those from seeds of the same varieties, are given in tabular form. The seedlings gave the earliest and largest returns.

Trimming.—"Plants of Potato Leaf, Golden Queen, Volunteer, and Bay State were headed back from 3 to 6 inches on all the leading shoots July 28 and August 25, and all the sprouts from the base of the plants were taken off. In every case there was an important gain in earliness and productiveness in favor of the trimmed plants. The labor of trimming is very slight, and it would appear to be profitable." Details are given in a table.

Double flowers and irregular fruit.—Observations on all the plants on a large plat at the time of blooming indicated that doubling of flowers is largely a varietal tendency, "some kinds having nearly all the first blossoms double, while on others none could be found. In Mikado, Morning Star, and a canner's variety from Salem County, New Jersey, the habit was most marked. In those varieties in which most of the first blossoms are double the first fruit of the succeeding cluster was double also; and those varieties which are most given to the production of such blossoms bear the greatest number of irregular fruits, as a rule. But the first blossom is by no means an index of the character of that plant, and this is true whether the variety is one in which the habit is marked, or one which simply chances to give an occasional double flower."

Notes on yields.—Observations made by the author on plantations of tomatoes in New York, Maryland, and Delaware are cited to show the importance of starting the plants early and forcing them rapidly in the North.

Impressions of varieties.—Only 40 varieties were grown at the station this season, including all the new kinds offered by the trade and local varieties sent in for trial. "We are still confirmed in our belief that varieties of tomatoes are unstable and that they soon run out. The strongest proof of this fact, perhaps, is the difficulty of maintaining any variety true to its type under good culture and careful selection." Experience with the Trophy is cited to illustrate this tendency. "It is a common but erroneous notion that 'running out' necessarily means deterioration." Brief descriptive notes are given for 26 varieties.

Summary.—(1) The tomato plant is quickly susceptible to careful selection.

(2) As elsewhere in the vegetable kingdom, the character of the plant, as a whole, appears to have more hereditary influence than the character of the individual fruit.

(3) Very heavy manuring does not lessen productiveness.

(4) Neither nitrate of soda nor muriate of potash alone are profitable tomato manures upon thin soil.

(5) Very early setting of stocky plants in the field, even in dark and raw weather, augmented earliness and productiveness this season.

(6) Seedlings gave far better results than cuttings.

(7) Trimming the plants lightly late in the summer gave a greatly increased yield.

(8) A double or monstrous flower upon a young plant is no indication that succeeding flowers upon the same plant will be double, and produce irregular fruits. But varieties which habitually bear double flowers are also the ones which habitually bear irregular fruits.

(9) Cool and dark weather in early fall, and early fall frosts are the leading drawbacks to profitable tomato culture in the North. To avoid these dangers as much as possible, plants must be started early and forced rapidly.

(10) The essential general points in profitable tomato culture are these: careful selection and breeding; early sowing; frequent, or, at least, occasional transplanting to obtain stocky plants; rich soil, well prepared and well tilled.

(11) There is evidence that varieties of tomatoes run out, even under good culture.

(12) The best market tomatoes appear from our tests to be Ignotum, Favorite, Bay State, Atlantic, and perhaps Ruby among the red varieties; Beauty, Mikado, and possibly Potato Leaf among the pink or purple varieties; Golden Queen among the yellow sorts.

(13) Among the novelties, Ruby and Chemin Market are most promising.

New York Cornell Station, Bulletin No. 22, November, 1890 (pp. 10).

ON THE EFFECT OF A GRAIN RATION FOR COWS, WITH PASTURAGE AND WITH GREEN FODDER, I. P. ROBERTS, M. AGR., AND H. H. WING, B. AGR.

Grain ration for cows at pasture.—This is in continuation of an experiment begun at this station in 1889 (See New York Cornell Station Bulletin No. 13; or Experiment Station Record, Vol. I, p. 280). The object of these experiments was to test the desirability of feeding a grain ration to cows at pasture by studying the effect upon the yield and quantity of the milk, the weight of the animals, and the natural decrease in milk flow with the advance of the period of lactation. Six cows were divided into two lots of three cows each, the lots being as nearly alike as practicable with respect to age, milking quality, live weight, and time since calving. Each lot contained one Holstein, one Jersey, and one native cow. The experiment extended from May 25 to September 27, eighteen weeks. During this time lot 1 had pasturage alone; and lot 2, pasturage and a mixed grain ration, consisting of 200 pounds of wheat bran, 150 pounds of cotton-seed meal, and 15 pounds of malt sprouts, the native cows receiving 6 pounds of this mixture and the other two 9 pounds daily. As it has been urged that "the effects of a grain ration would probably be more marked with cows that had been poorly wintered and that came into milk in the spring thin in flesh than with our cows, that are kept in good flesh all the year round," two native cows, which had calved at the same time and "were both very thin in flesh," were used in the experiment of 1890, one in each lot. "The pasture, the same as was used in 1889, was almost entirely blue-grass, on a dry, gravelly upland soil." The cows were in the pasture both day and night. The pastures were in good condition, except from July 13 to August 16, "during which time the pastures became very dry and bare and were supplemented with second-growth clover."

Analyses were made of the milk at first three times each week, and later three times each fortnight, the samples for this purpose being mixtures of the morning and evening milkings of the three cows of each lot for one day. The average daily yield of milk, the average percentage of total solids and fats in the milk, and the average production of butter fat per cow are tabulated for each lot. The total amount of butter fat produced per cow during the entire experiment was, for lot 1 (pasturage alone), 118.14 pounds, and for lot 2 (pasturage and grain), 119.72 pounds.

It will be at once seen that, as in 1889, we received no return in the production of butter fat from the grain fed. In the whole experiment we have 1.58 pounds per cow, or about 4¾ pounds in all to show for the consumption of 2,822 pounds of wheat bran and cotton-seed meal by lot 2. The manurial value of the grain fed and the saving in the amount of pasture consumed by the grain-fed cows would amount to considerable, but not enough, by far, to counterbalance the extra cost of the grain ration. While in both years there was, as was to be expected, a continual decrease in the flow of milk, in 1889 the decrease in the grain-fed lot was much greater and more rapid than in the lot that had only pasture; but in 1890 the decrease was much more nearly even and was slightly less in the grain-fed lot. There was also a difference in the varying percentages of fat in the milk of both lots in the two seasons that may be, and probably is, due to the difference in the state of the weather and the pastures.

On one day of each alternate week a separate sample of the milk of each of the native cows was taken and analyzed. The averages of the total butter fat shown by these analyses, compared with the average total amount of butter fat produced per cow by each lot during the entire experiment, were as follows:

	Lot 1. Pasturage.	Lot 2. Pasturage and grain.
Average total butter fat produced per cow	118.14	119.72
Total butter fat produced by thin cow (native)	113.79	84.27

It will be seen that not only did the thin cow fed on pasture and grain not yield more milk and butter than her companion that had nothing but grass, but in fact she yielded considerably less. At the time that the selection was made it was thought that the former would in all probability be most likely to be favorably affected by the grain ration. She was the younger, rather the thinner, and seemed to have rather more vitality. For these reasons she was selected to receive the grain ration. She failed entirely to respond to the grain feed in milk and butter, but did gain considerably more in weight, as will be seen when we come to make a study of the changes in live weight.

This comparison shows the importance of numbers in eliminating individual peculiarities. While each lot as a whole produced almost the same amount of butter fat, in the separate members of each lot there were very considerable differences.

The animals were weighed once a week, in the morning after milking. The table of these weights shows that "the thin cows, No. 3 in each lot, were the ones that made the largest gains," the one in lot 1 (pasturage) gaining 67 pounds and the one in lot 2 (pasturage and grain) gaining 208 pounds during the whole experiment. Except in the case of one cow in lot 2 and these two native cows there was a loss in live weight during the whole experiment amounting to from 10 to 93 pounds, so that the average live weight of lot 1 (pasturage alone) was 37 pounds less per animal, and that of lot 2 (pasturage and grain) only 77 pounds more than at the beginning of the experiment.

Grain when cows are soiled.—In this experiment, which was similar to the one detailed above and which was carried on at the same time, the cows were kept in the barn and fed freshly cut grass instead of being at pasture. Two lots of three cows each were used. "The ex-

periment was begun May 25, up to which time both lots had been fed on hay and the same amount and kind of grain that lot 4 continued to receive, and lasted for five weeks. Each cow had furnished to her all the freshly cut grass, clover, and timothy, in about equal proportions, she would eat in two feeds per day, and the cows in lot 4 had in addition 9 pounds each per day in two feeds of the same grain mixture that was fed lot 2" in the previous experiment. "In the first two weeks [period I] the grass was tender and succulent; after that [period II], as it approached maturity, it constantly became dryer and harder." The following statement summarizes the results of the experiment.

Yields of milk and butter fat, and amounts of cut grass consumed.

	Average daily yield of milk per cow.		Average percentage of fat in milk.		Average amount of butter fat produced per cow weekly.		Average amount of cut grass consumed weekly by each lot.	
	Lot 1, cut grass.	Lot 2, cut grass and grain.	Lot 1, cut grass.	Lot 2, cut grass and grain.	Lot 1, cut grass.	Lot 2, cut grass and grain.	Lot 1, cut grass.	Lot 2 cut grass and grain
	Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	*Pounds*	*Pounds.*	*Pounds*	*Pounds*
At the beginning of the experiment	23.93	30.05	3.17	3.10	5 31	6 51	....	... ...
During period I (May 24 to June 7).	21.88	31.48	3.53	3.27	5 33	7.20	3,187	3,029
During period II (June 7 to June 28)	14.19	29.34	3.62	3 28	3.59	6.75	2,362	2,362

During the first two weeks of the trial the amount of grass eaten by lot 1, which had grass alone, was 158 pounds more than that eaten by lot 2, which had grass and grain; but during the three weeks following, the consumption of grass was the same for both lots. "When the grass was so succulent that the cows having no grain would eat more of it than those having grain, the milk and butter yield remained constant in both lots. When the grass became so hard that those having no grain would eat no more than the ones having grain, the grain fed lot forged ahead in milk and butter production. But in neither period was the grain fed at a profit."

Lot 1 (pasturage) produced during the entire experiment 32.05 pounds of butter fat per cow, and lot 2 (pasturage and grain) 47.68 pounds. "That is, there was received in the whole experiment not quite 47 pounds of butter fat [and the increased value of the manure] to show for a consumption of 963 pounds of grain, but the grain-fed lot were giving a little more than a pound of butter fat per cow per week at the beginning, which alone in the five weeks would account for 15 pounds of this difference. Perhaps the most marked effect in this trial was the way in which the grain-fed cows (lot 4) maintained their flow of milk as the grass grew harder. This is the more noticeable from the fact that all the cows were far advanced in calf and close upon the time when they might be expected to rapidly decrease in milk yield."

Conclusions.—In two trials in two seasons we have received no return in milk and butter from feeding a grain ration to cows on good pasture.

In one trial with cows soiled on fresh grass we have received in increased milk and butter production and in saving of grass consumed barely enough to pay for the cost of the grain ration added.

In neither case has any allowance been made for increased value of manure when grain is fed, which would be considerable in amount, but exceedingly difficult to estimate with exactness.

We are still of the opinion that several repetitions of this experiment will be needed before the matter can be considered conclusively settled.

North Carolina Station, Bulletin No. 72, June 1, 1890 (pp. 16).

THE WORK OF THE HORTICULTURAL DIVISION, W. F. MASSEY, C. E. (pp. 3–10).—But little systematic work in horticulture had been undertaken by the station up to December, 1889, when the author was appointed horticulturist. During 1890 a number of varieties of large and small fruits have been planted, and comparative tests of such vegetables as are commonly grown in the South for shipment to Northern markets have been begun. These include peas, cabbages, tomatoes, Irish and sweet-potatoes, and sweet-corn. With a view to producing an early variety of sweet-corn suited to North Carolina, seed of a number of early Northern varieties has been procured, from which by crossing and selection it is hoped to obtain a desirable variety. Twenty-two varieties of Irish potatoes, 11 of sweet-potatoes, 40 of tomatoes, and 40 of peas were grown in 1890. Early and late cabbages will also be tested, and an attempt made to grow *Pyrethrum roseum* and *cinerarifolium*, from which powder may be made for insecticidal uses. The additions to the small and large fruits previously grown at the station include 40 varieties of apples, 40 of peaches, a number of grapes, 36 varieties of figs, a California plum (*Prunus subcordata*), and 2 varieties of Japanese orange (*Citrus trifoliata* and Satsuma). It is proposed to illustrate at the station various methods of pruning and training grapes, to study insects and fungous diseases of plants with a view to devising remedies, and to do something in ornamental horticulture and arboriculture. An arboretum will be begun on the college grounds and a new greenhouse will be constructed. The list of plants now growing at the station, as given in the bulletin, includes 57 varieties of apples, 9 of pears, 51 of peaches, 21 of plums, 6 of cherries, 3 of quinces, 6 of nuts, 123 of grapes, 36 of figs, 8 of raspberries, 7 of blackberries, 17 of strawberries, 2 of currants, 2 of gooseberries, and 13 of osier willows.

VALUE OF PEA-VINE MANURING FOR WHEAT, J. R. CHAMBERLAIN, B. S. (pp. 11–13).—To test the value of pea vines as a green manure in preparing land for wheat, land from which a crop of cabbages had been taken off was divided into equal parts, and black cow-peas sown on one half, while the other half remained vacant. Owing to late sowing the pea vines had not reached maturity at the time they were plowed in (middle of October). Seven plats were laid out so that one half of

each plat was on the land in which pea vines had been plowed, and the other half on the part that had lain idle during the summer, a space of 10 feet being left between the two halves. The plats were one twenty-fifth of an acre each. They were sown to wheat (a mixture of Fultz and Fulcaster varieties), November 13, 1888, at the rate of one half bushel per acre. Just before seeding, fertilizers, as indicated in the table below, were applied to five of the plats, two remaining unmanured. Thus the two halves of each plat were treated exactly alike except that one half had pea vines and the other had none. The following table gives the amount and cost of the fertilizers applied, and the yields of grain on both halves of each plat, calculated for one acre.

Yields of wheat with and without pea vines.

No.	Application of fertilizer per acre.	Cost.	Yield per acre without peas. Bush.	Lbs.	Yield per acre with peas. Bush.	Lbs.
1	None		15	40	25	40
2	300 pounds kainit	$2.10	14	10	29	10
3	300 pounds acid phosphate	2.63	18	20	31	40
4	175 acid phosphate; 87½ cotton-seed meal; 87½ kainit	2.84	16	40	25	50
5	None		13	20	23	20
6	300 pounds cotton-seed meal	3.60	17	30	23	20
7	350 acid phosphate; 175 cotton seed meal; 75 kainit	5.68	15	40	22	30
	Total		111	20	181	30

The average increased yield where pea vines had been plowed in was, therefore, 10 bushels of wheat per acre. "One single experiment does not prove a truth. In the fall of 1889 this experiment was repeated, and probably will be continued several years. In view of these facts, it will be better to wait till the series of experiments have been finished before farther conclusions be presented."

Oregon Station, Bulletin No. 6, July, 1890 (pp. 16).

Examination of cattle foods, P. H. Irish, Ph. D. (pp. 3–9).

Comparative digestibility of cooked and uncooked silage.—The experiment was made to determine the comparative digestibility of cooked and uncooked corn silage when fed to sheep. The silage used was made from an overripe dent corn and "was in first-class condition" when fed. One Shropshire wether was used for the trial. The animal was fed for a time on uncooked silage, and then, in a transition period, changed to cooked silage. The lengths of the feeding and transition periods are not stated. For one week in the latter part of each trial the excrement was collected, weighed, and analyzed. An analysis of the silage used is given. Determinations of dry matter in the silage offered and rejected were made each day.

The results of the experiment are summarized in the following statement, which gives the percentage of each ingredient of the cooked and uncooked silage found to be digested.

Co-efficients of digestibility.

	Crude protein.	Crude fat.	Crude fiber.	Crude ash.	Nitrogen-free extract.
	per cent.	*per cent.*	*per cent.*	*per cent.*	*per cent.*
Cooked silage	39.43	87.24	70.33	30 96	74.75
Uncooked silage	45.41	86.11	59.19	31.98	71.06

Comparative determinations of the amount of sugar dissolved out from cooked and uncooked silage by standing in cold water about twelve hours showed 3.09 per cent of glucose in the dry matter of the cooked, and 1.86 per cent in that of the uncooked material.

The effect of the cooking of silage as indicated by these observations was: "(1) to decrease the digestibility of the nitrogenous substances; (2) to increase the digestibility of crude fiber; (3) to increase the digestibility of nitrogen-free extract; (4) to increase the digestibility of fat; (5) to increase the amount of sugar contained in the silage."

Ethyl alcohol in silage.—About 500 grams of silage were distilled, the distillate neutralized, redistilled, and finally subjected to fractional distillation. The characteristic odor of benzo-ethyl-ester with benzoyl-chloride, and the iodiform reaction, were observed in the portion separated at 65° C. The author concludes that "alcoholic fermentation takes place in the silo, by which ethyl alcohol is formed."

ECONOMIC ZOOLOGY, F. L. WASHBURN, B. A. (pp. 10–16).—A circular asking information regarding benefits and injuries by birds and mammals in Oregon is given as sent out by the station, together with a tabulated summary of replies from twenty-three persons.

Rhode Island Station, Bulletin No. 8, September, 1890 (pp. 30).

SOILS AND FERTILIZERS, H. J. WHEELER, PH. D. (pp. 67–98).—Popular discussions on the following subjects: Soils, their origin, analysis, and renovation; agricultural chemicals and their use; commercial valuation of fertilizers, together with analyses of fertilizing materials, taken from the Seventh Annual Report of the Massachusetts State Station; and composition of potash and magnesia salts which are of agricultural importance, taken from the publications of the Stassfurt Potash Syndicate, Germany.

South Dakota Station, Second Annual Report, 1889 (pp. 56).

REPORT OF DIRECTOR, L. MCLOUTH, PH. D. (pp. 5–12).—Brief statements regarding the history, organization, and work of the station, and a financial report for the year ending June 30, 1889.

REPORT OF AGRICULTURIST, L. FOSTER, M. S. A. (pp. 13–27).—Abstracts of Bulletins Nos. 9 and 11 (See Experiment Station Record, Vol. I, pp. 18, 19), with brief notes on experiments in progress with grasses, clovers, sugar-beets, potatoes, horses, cattle, sheep, and hogs.

REPORT OF HORTICULTURIST AND BOTANIST, C. A. KEFFER (pp. 28–47).—Brief accounts of the work on the germination of frosted grain recorded in Bulletin No. 10 of the station (See Experiment Station Record, Vol. I, p. 19); on fruits, in Bulletin No. 7; on vegetables, in Bulletin No. 5; on forestry, in Bulletins Nos. 12 and 15 (See Experiment Station Record, Vol. I, pp. 20 and 315).

REPORT OF CHEMIST, J. H. SHEPARD, M. A. (pp. 48–50).—Brief notes on analyses of waters, reported in Bulletin No. 8; and on experiments with the sugar-beet, in Bulletin No. 14 of the station (See Experiment Station Record, Vol. I, p. 22).

REPORT OF ENTOMOLOGIST, I. H. ORCUTT M. D. (pp. 51–56).—Abstract of Bulletin No. 13 of the station (See Experiment Station Record, Vol. I, p. 21).

Tennessee Station, Bulletin Vol. III, No. 4, October, 1890 (pp. 8).

PRACTICAL EXPERIMENTS IN RECLAIMING "GALLED" OR WASHED LANDS, WITH NOTES ON MULCH AND MULCH MATERIALS, P. F. KEFAUVER (pp. 65–72).—Brief accounts are given of sixteen experiments by the author, from 1878 to 1890, inclusive, in reclaiming hillside land on a farm in Monroe County, Tennessee, from which the soil had been washed, leaving exposed the clay and slate subsoil, scarred by deep gullies. Success was not attained until stable manure was liberally used, together with mulches. Clover and Bermuda grass seem to have been especially valuable as crops on this land. There are also brief notes on five similar experiments on land differently situated. Attention is called to the action of microbes in helping to make atmospheric nitrogen available to leguminous plants and it is stated that these microbes multiply to an enormous extent in the decaying vegetable substances in mulches. Statements on the value of clover halm as a mulch are quoted from the Annual Report of the station for 1883 (pp. 135,136) and reference is made to experiments with damaged silage as a mulch on corn, recorded in the annual reports of the station for 1882–86. Green weeds and straw from stubble fields are recommended as good materials for mulching.

"Sedge grass deserves special mention on account of cheapness, abundance in many sections, extent of land covered by a given amount—four loads per acre for grass or clover—and general efficiency. It is especially valuable and practicable for 'galled' hillsides or on thin land where it is desirable to grow a crop of clover to turn under. It settles very close to the ground after the first rain, effectually prevents washing, and will not blow off after once becoming settled."

The following is a list of the materials used for mulch by the author,

in the order in which he values them: clover halm, damaged silage, green weeds and straw from stubble field, sedge grass, briers, weeds and trash from fence corners, partially rotten straw, straw, sorghum cane pomace, dry weeds and trash from clover fields in spring, and brush.

Utah Station, Bulletin No. 2, November, 1890 (pp. 13).

PLOW TRIALS, J. W. SANBORN, B. S.—This bulletin includes brief accounts of experiments by the author and A. A. Mills, B. S., superintendent of farm experiment work at the station, in which the draft of plows used under different conditions was determined with the dynamometer. The details of these experiments will probably be published in the annual report of the station. Reference is also made to previous experiments by the author, recorded in Bulletin No. 4 of the Missouri Station. The nature of the trials made at the Utah Station, as well as the conclusions drawn by the author, are indicated in the following summary taken from the bulletin.

The question of the draft of plows is a very important one. In round numbers 200,000,000 days of horse work is used annually in plowing for the staple crops of this country. A change in the draft of 10 to 30 per cent, which may easily occur, as a difference between good plows and plowing and poor plows and plowing, may not affect the visible as much as it does the invisible cost of plowing; nevertheless the cost occurs. Invisible costs are of more concern to us than visible costs. In case of plowing, extra cost of plowing may occur in the character of the work, or extra hardship to the plowman and the horses. The dynamometer trials represent only the tax upon the horse. No useless or extra tax can be put upon the horse without either an unavoidable extra cost of food or decrease in the weight or in the vigor of the horse. The tax will probably occur in all three of above directions. In addition to the recorded extra draft found as the result of the changes recorded in this bulletin, there are other losses liable to be involved. These will be found in the character of the work done, extra exertion to the plowman, and extra wear to the plow.

Conclusions.—(1) Coulters add to the draft of plows.

(2) Trucks under the end of the beam lessen draft and add to the uniformity of the furrow and decrease the work of the plowman.

(3) A share sharpened by a blacksmith [but so that the point had too much dip and an irregular cutting edge], drew 36 per cent harder than a new share.

(4) A dull share drew harder than a sharp one, but not as hard as a poorly sharpened share.

(5) Less loss of draft was found when the plowman forced the plow to carry a furrow out of harmony with the hitch at the bridle than it was expected would be found.

(6) When the sulky plow was forced to take land by adjustments by the pole forming a line at an angle with the plow, there was a loss of draft.

(7) No loss of draft was found either when the share was made straight on its base or straight on its land side; on the contrary, a slight gain was recorded.

(8) Lengthening the hitch slightly decreased the draft of the plow.

(9) Changing plowmen varied the draft, but not so materially as it has been supposed it would.

(10) A three wheeled sulky plow, having no pole—the third wheel running in the furrow and allowing of a shorter land side—gave a light draft and excellent work.

(11) Walking plows gave very slightly less draft than did sulky plows with rider, but not a material difference.

(12) The wider the furrow up to the standard cutting width of the plow, the less the force required to turn a square inch of soil. After passing this width the draft on a clover sward still very slightly continued to decrease. On old ground it did not decrease beyond this point.

(13) Draft decreased with depth and probably will as long as the soil retains the essential physical conditions of the surface.

Vermont Station, Bulletin No. 21, September, 1890 (pp. 26).

A NEW MILK TEST.—This test depends upon dissolving the curd (casein, albumen, etc.) of 15 cubic centimeters of milk in a mixture of hydrochloric acid and amyl alcohol with concentrated sulphuric acid, and then whirling the bottles containing the liquid in an improved centrifuge (a modification of Beimling's patent) from one half to one minute, when the clear fat will be found collected in the narrow neck of the test bottle. No heat or hot water is used in the separation. The reading of the fat column by the graduation on the neck of the bottle indicates the percentage of fat in the milk directly, without calculation.

"The centrifugal machine consists of a central axis, to which are attached as many pockets as are desired. Machines are usually made to contain 3, 6, 12, or 24 pockets. The pockets are attached to the shaft by a hinge-joint that enables them to hang perpendicularly when the machine is at rest, but allows them to straighten out horizontally when they are revolved. By this means there is no danger of loss from spilling on starting or stopping, even when the bottles are nearly full. The pockets are water-tight, so that should a bottle break its contents could not do any damage. * * * The conditions of a successful test are: an acid liquid, colored more or less purple; a clear, cloudless column of fat; and either no undissolved casein whatever, or but a thin layer (one thirtieth of an inch). If much casein remains, or the fat be cloudy, the result will be likely to be untrustworthy, and the test should be repeated. * * * In a set of twenty-four samples, in which the work with the new machine was done by one who had never used the machine but once before, 75 per cent of the results agreed with the Adams gravimetric method within a tenth of 1 per cent and in no result was there as much as three tenths difference."

Skim and buttermilk containing less than 1 per cent of fat can not be accurately tested by this method. In testing cream 10 cubic centimeters diluted with water may be used in the ordinary testing bottle, the reading being corrected by the factor 1.45. The time required for a single test is not more than five minutes, or twenty-five determinations can be made in an hour. The cost of chemicals does not exceed one fifth of a cent per test. The centrifugal machine, which is patented, costs from $20 to $50, according to size, one carrying six tubes costing, with test bottles, $25.

TESTING MILK AT CREAMERIES AND CHEESE FACTORIES.—The results are given of analyses of twenty-seven samples of milk brought by as many patrons in one day to a creamery in the State, which at the time was paying 60 cents per hundred pounds for all milk delivered. These show "a variation from 3.35 per cent of fat to 4.91 per cent, or from milk worth 52 cents a hundred to that worth 74 cents, *i. e.* 100 pounds of the richest milk is worth 142 pounds of the poorest."

A careful study of the herds of this State will show the evil effects of the present method of paying for milk. Wherever in this State a cheese factory has been run for many years it will be found that the herds in that vicinity all give thin milk and will produce but a small number of pounds of butter a year. The reason of this is evident. The patrons have been paid entirely by the weight of their milk, and so all their efforts in breeding have been directed to getting cows that would give the largest quantity of milk without regard to its quality, and as a large flow of milk is almost always accompanied with a poor quality of milk, the natural result is that the general character of the milk of the neighborhood is lowered. But the evil goes farther than this. Cows that give this large flow of milk that is watery usually dry up quickly, and there will be found all through this State, in the vicinity of cheese factories, herds of cows of large form and large udders, which are large consumers of food, give a large flow of thin milk during May and June, and are pretty well dried up by October, so that the total amount of milk produced per cow per year is less than 3,000 pounds, and the total butter which this milk will make is scarcely more than 100 pounds. On the contrary, the best herds in the State will be found where the product of the herd has been used at home in making butter, and the breeding has been with the view of getting the cow that would make the most butter per year on moderate food. * * * The method of analysis discussed in this bulletin is so easy and cheap that it would be a very simple matter for each patron of the creamery or cheese factory to bring to the factory samples of milk of his individual cows and learn which were good cows and which ones should be discarded. In this way a single machine at a central point would be sufficient to test the milk of several hundred cows. Any one can see at once what an immense stride Vermont dairying would make under these conditions.

It is stated that "where the milk is paid for according to the weight a premium is put on watering or skimming," and that "we have found samples of milk that had been tampered with in every one of the more than twenty creameries that we tested." According to a plan proposed for sampling at creameries, the milk, instead of being sampled each day when it is brought, is sampled about three times a week, the samples of each patron's milk being preserved by means of corrosive sublimate, and a single analysis made of the composite sample at the end of a week or ten days. A small quantity of some aniline color is added to the milk to prevent accidental poisoning. A simple sampling tube is described.

To ascertain the error involved by taking samples of equal size each day, instead, as proposed by Professor Patrick, of taking a sample proportional in size to the quantity of milk brought, tests were made of eighteen lots of creamery milk. Samples were taken daily by both methods for four days. The amounts of butter fat, as indicated by analyses of each lot of samples, are given, together with the differences between the two series of determinations.

The average of these differences is less than a tenth of a pound of butter fat in 4 days. Had the samples been taken for 7 days the differences would have been still smaller. The largest difference is two thirds of a pound, and this is on a large lot of over a hundred pounds of butter fat.

In the light of these results it is evident that the taking of samples for analysis that vary in size with the quantity of milk is a needless precaution, and that in actual practice it is better to have a single sampling cup for all the work. The author advocates the adoption of the fat test as a basis for paying for milk at cheese factories, as well as creameries.

"In general, it is true that the more fat the milk contains the more casein it also contains, so that the amount of cheese to be made out of the milk can be very accurately gauged by the amount of fat it contains. It is also true that the market value of the cheese comes almost entirely from the fat. * * * A method to be just to all, however, must take into account both the casein and the fat. This can be arrived at quite closely by paying a certain amount for the milk by weight, without regard to its quality, and a certain amount additional for each pound of butter fat it contains."

NOTES FOR THE LABORATORY.—It is believed that in the hands of an experienced manipulator the method above described is capable of being brought to a high degree of accuracy. Suggestions for its use in laboratories in testing cream, butter, and cheese, as well as milk, are given.

EXPERIMENT STATION NOTES.

COLORADO COLLEGE AND STATION.—C. P. Gillette, M. S., of the Iowa Station, has been elected professor of zoology and entomology in the Colorado College, and entomologist of the station.

FLORIDA STATION.—Investigations have been begun with reference to methods of growing oranges and the diseases and insect enemies of this fruit.

GEORGIA STATION.—A stable and barn 75 by 42 feet, and a chemical laboratory 40 by 40 feet are nearly completed. Dr. Charles Herty, assistant chemist, will take charge of the new laboratory February 1, 1891. The State legislature has appropriated $6,500 for building purposes.

MISSISSIPPI STATION.—The office building has been enlarged to provide additional rooms for the library, work in botany and entomology, and the storage of seeds and samples.

NEW HAMPSHIRE STATION.—The station staff expect to spend about a month during the winter in explaining the results of the work of the station to the farmers in farmers' institutes.

NEW YORK CORNELL STATION.—A three-story structure, 30 by 40 feet, has been added to the farm buildings. A portion of this building will be used for experiments in breeding and feeding swine. A Babcock milk-tester is now in use in the dairy.

PENNSYLVANIA COLLEGE AND STATION.—T. F. Hunt, B. S., assistant agriculturist the Illinois Station, has accepted the position of professor of agriculture in the Pennsylvania College, and agriculturist of the station.

UTAH STATION.—Tests of the draft of wagons, under different conditions and on various kinds of roads, with the dynamometer, have been completed.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

DECEMBER 1, 1890, TO FEBRUARY 1, 1891.

DIVISION OF ENTOMOLOGY:

Periodical Bulletin, Vol. III, No. 4, November, 1890.—Insect Life.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, Vol. II, No. 5, December, 1890; and No. 6, January, 1891.

DIVISION OF VEGETABLE PATHOLOGY:

Bulletin Vol. VI, No. 3.—Journal of Mycology.

DIVISION OF STATISTICS:

Report No. 80 (new series), December, 1890.—Report of the Crops of the Year, and Freight Rates of Transportation Companies.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

DECEMBER 1, 1890, TO FEBRUARY 1, 1891.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Bulletin No. 19, October, 1890.—Roads and Road Making; Meteorology.

Bulletin No. 20, November, 1890.—Small Fruits, Melons, and Vegetables; Report of Alabama Weather Service.

ARKANSAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 15, December, 1890.—Some New Insecticides and Their Effect on Cotton Worms.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF CALIFORNIA:

Bulletin No. 89, December 10, 1890.—Distribution of Seeds and Plants.

COLORADO AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 13, October, 1890.—The Measurement and Division of Water.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 105. December, 1890.—Notice as to Supply of Station Reports for 1890 and Bulletins for 1891; Corrections; The Potato Scab; The Proteids of the Oat Kernel; Milk Testing.

AGRICULTURAL EXPERIMENT STATION OF FLORIDA:

Bulletin No. 11, October, 1890.—Experiments with Corn and Irish Potatoes, and Analysis of Grasses, Etc.

GEORGIA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 8, July, 1890.—Irish-Potato Culture.

Bulletin No. 9, October, 1890.—Potash and Paying Crops.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ILLINOIS:

Bulletin No. 12, November, 1890.—Field Experiments with Oats, 1890; Milk and Butter Tests; Cream Raising by Dilution; The Hessian Fly; Canada Thistles, their Extermination.

Third Annual Report, 1889-90.

AGRICULTURAL EXPERIMENT STATION OF INDIANA:

Bulletin No. 33, October, 1890.—Small Fruits; Entomological Notes; The Absorptive Power of Soils.

KENTUCKY AGRICULTURAL EXPERIMENT STATION;

Bulletin No. 31, December, 1890.—Some Strawberry Pests.

NORTH LOUISIANA EXPERIMENT STATION:

Bulletin No. 5 (second series).—Sugar Making on a Small Scale.

MARYLAND AGRICULTURAL EXPERIMENT STATION:

Special Bulletin, October, 1890.—Composition of Commercial Fertilizers Sold in this State.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:

Analyses of Commercial Fertilizers, November, 1890.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Bulletin No. 11, January, 1891.—Strength of Rennet; Hay Caps; Flandres Oats; Prevention of Potato Rot; Fungicides on Fruits.

Meteorological Bulletin No. 23, November, 1890.

Meteorological Bulletin No. 24, December, 1890.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:

Bulletin No. 67, October, 1890.—Fruit Testing at the South Haven Substation.

Bulletin No. 68, October, 1890.—The Jack-Pine Plains: Silage; Milk and Fertilizer Analyses.

Bulletin No. 69, November, 1890.—Feeding Steers of Different Breeds.

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 11, November, 1890.—Pig-Feeding Experiments.

NEW JERSEY STATE AND COLLEGE EXPERIMENT STATIONS:

Bulletin No. 75, November 7, 1890.—Insecticides, and How to Apply Them; Experiment Record for 1890.

Bulletin No. 76, November 28, 1890.—Some Fungous Diseases of the Sweet-Potato.

Bulletin No. 77, December 11, 1890.—Experiments with Different Breeds of Dairy Cows.

Special Bulletin K, February 28, 1890.—The Insects Injuriously Affecting Cranberries.

Special Bulletin L, April 22, 1890.—Observations upon the Peach for 1890.

AGRICULTURAL EXPERIMENT STATION OF NEW MEXICO:

Bulletin No. 1, April, 1890.—Announcements.

Bulletin No. 2, October, 1890.—Announcements.

NEW YORK AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 24 (new series), October, 1890.—Experiments with Strawberries; Description of Varieties; The Most Profitable Varieties; Influence of Pollen; Reports from Other Sections.

Bulletin No. 25 (new series), November, 1890.—The New York State Fertilizer Control and Fertilizer Analyses.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 23, December, 1890.—Insects Injurious to Fruits.

Bulletin No. 24, December, 1890.—The Clover Rust.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 73*a*, October, 15, 1890.—Meteorological Summary for North Carolina, September, 1890.

OHIO AGRICULTURAL EXPERIMENT STATION:

Bulletin Vol. III, No. 8 (second series), September, 1890.—Plum Curculio Experiments: Remedies for the Striped Cucumber Beetle: The Rhubarb Curculio; The Clover-Stem Borer; Potato-Blight Experiments.

Bulletin Vol. III, No. 9 (second series), October, 1890.—Asparagus: Transplanting Onions.

THE PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 13, October, 1890.—Black Knot on Plums; A Few Ornamental Plants.

Bulletin No. 14, January, 1891.—Tests of Varieties of Vegetables for 1890.

RHODE ISLAND STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 8, September, 1890.—Soils and Fertilizers.

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 19, December, 1890.—The Sugar-Beet.

Third Annual Report, 1890.

TENNESSEE AGRICULTURAL EXPERIMENT STATION:

Bulletin Vol. III, No. 4, October, 1890.—Practical Experiments in Reclaiming "Galled" or Washed Lands; Notes on Mulch and Mulch Materials.

Bulletin Vol. III, No. 5, December, 1890.—Fruit-Trees at the Experiment Station.

VERMONT STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 22, October, 1890.—Test of Dairy Cows; Home *vs.* Fair Grounds.

Third Annual Report, 1889.

WEST VIRGINIA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 8, June, 1890.—Summary of Meteorological Observations, and Reports of Correspondents on Conditions of Agriculture, Etc.

Bulletin No 9, July, 1890.—Additional Reports upon Wheat Distributed in 1889; Meteorological Report for July; Reports of Correspondents upon Meteorology and Crops for July.

Bulletin No. 10, August, 1890.—Meteorological Report for August; Reports of Correspondents upon Meteorology and Crops for August.

Special Bulletin.—Potash and Paying Crops.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF WISCONSIN:

Seventh Annual Report, 1890.

DOMINION OF CANADA.

DEPARTMENT OF AGRICULTURE:

Annual Report, 1889.

GUELPH AGRICULTURAL COLLEGE:

Bulletin No. 56, December 9, 1890.—Smut, its habits and remedies.

Bulletin No. 57, December 16, 1890.—Sugar-beets.

EXPERIMENT STATION RECORD.

Vol. 2. March, 1891. No. 8.

EDITORIAL NOTES.

The following statements regarding the Austrian agricultural experiment stations are taken from an account of these stations* published by the Austrian Ministry of Agriculture on the occasion of the Agricultural and Forestry Exhibition held in Vienna in 1890.

There are at present four governmental experiment stations (*staatliche Versuchsanstalten*). These receive a part of their support from the Austrian Imperial Government. There are sixteen stations which are not governmental (*nicht-staatliche Versuchsanstalten*). Of these, seven are not directly connected with any educational institution, and nine are connected with eight agricultural schools. Chemical or other investigations in agricultural lines are carried on in at least seven other schools. Several of the non-governmental stations are established and supported by societies, and some receive financial aid from provincial governments. Most of the stations and laboratories receive fees for analyses and other investigations, which in a number of cases are the principal source of revenue of the stations. The number of analyses and examinations made for farmers and other private individuals has greatly increased during the past few years. Most of the stations have adopted a fixed schedule of fees for private work, a reduction being often made to the members of the agricultural societies which support the stations, or when the results are likely to be of general interest. A few stations, however, do work of this kind free of charge. An important feature of the Austrian stations is the training of young men in the methods of station work and the giving of practical instruction to persons engaged in the sugar, alcohol, silk, and other industries, many of the assistants in the laboratories being volunteer workers, who receive no pay.

*Das Land- und Forstwirtschaftliche Versuchswesen in den im Reichsrathe vertretenen Königreichen und Landern, Wien, 1890, pp. 113.

The governmental experiment stations are the following:

(1) *The agricultural-chemical experiment station at Vienna.*—This was established in 1869. Its work includes scientific researches; analyses of fertilizers, feeding stuffs, and other technical products; and the giving of information by lectures, consultations, and correspondence. The work of research has to do mainly with the study of the laws of nutrition of animals and plants, the values of foods and fertilizers, the culture of plants, and methods of inquiry. The working force consists of a director, five assistants, and two helpers. The station has feeding stalls and a Pettenkofer's respiration apparatus. It has no land, but utilizes very satisfactorily the land and assistance of farmers in different places for experiments. The analyses of fertilizers, feeding stuffs, products of the dairy, sugar, alcohol and other commercial products, water, ores, etc., are in large part paid for by the parties in whose interest they are made. The number of these paid analyses increased from 81 in 1877 to 12,180 in 1889, the corresponding receipts being $95 in 1877 and $9,890 in 1889. The expenditures of the station in 1889 were $11,600. The station has been represented in numerous agricultural expositions in Austria and other countries. The details of its organization and work and the indications of its steady and healthy growth in usefulness and public esteem are very interesting.

(2) *The chemical-physiological experiment station for wine and fruit culture at Klosterneuburg* was established in 1870. This station conducts abstract researches, more immediately practical experiments, and analyses and tests of products in the interests of the industries it represents. These include chemical, microscopical, and other investigations on wine, yeast, the by-products of wine manufacture, the adulteration of wine, vineyard soils and fertilizers, and the diseases of grapes and other fruits. In 1889 the station received about $1,500 for investigations and analyses made for private individuals.

(3) *The experiment station for silk and wine culture at Görz*, established in 1868, was the first Government experiment station in Austria. An important part of its work consists of investigations with reference to the conditions essential to the successful production of silk cocoons, and the improvement of breeds of silk-worms. The benefit to the silk industry has been very great. In wine culture its operations, which begun in 1879, are along the same general lines as those at Klosterneuburg. Investigations in other branches of agricultural science are carried on. A large number of chemical and miscroscopical examinations are made for private individuals. An interesting feature of the station's activity is the giving of annual or biennial courses of lectures, with practical demonstrations, in wine, and especially in silk culture to people engaged in those industries. These courses have been in the Italian and Slavonic languages. The courses in silk culture have been attended by 494 men and 64 women, while 89 persons have attended those on wine and fruit culture.

(4) *The forestry experiment station at Mariabrunn*, established in 1874, aims at the development of scientific principles underlying the rational management of forests. Private forests, as well as those belonging to the Government in different parts of Austria, are used for observation. The station is provided with forest gardens for experiments with fertilizers and a nursery for experiments in growing forest-trees. In 1889 this was made a control station for forest seeds. Investigations in entomology and mycology, and especially in meteorology as related to forestry, are also carried on here. In 1889 the income of the station was about $9,000. The regular working force includes a director, three assistants, a forester, and two gardeners. Besides these, numerous workmen are temporarily employed.

The following stations are not directly under governmental control, though most of them receive more or less aid from the Government.

(1) *The seed-control station of the Agricultural Society of Vienna*, established in 1881, makes examinations of seeds and exercises a seed control. It also tests specimens of feeding stuffs, malt, hops, etc. In the season of 1888–89 it made, in behalf of dealers and purchasers, 4,486 examinations of 2,201 specimens of seeds and 65 of feeding stuffs. In the same season 48 field experiments with seeds were made in different places, 26 being on peasant farms. The station receives from the Government from $300 to $400 per year, the balance of its support coming from fees received for examinations of seeds, etc. The working force includes a director, two assistants, and a laboratory helper.

(2) *Chemical-technical experiment station of the Central Society for Beet Sugar Industry in the Austro-Hungarian Empire, at Vienna.*—This may be regarded as the oldest experiment station in Austria. It was established in 1859 at Königsaal in Bohemia, in connection with the first sugar-beet factory in Austria. It was removed in 1867 to Prague, and in 1871 to Vienna, where it is conducted and supported by the society named. It represents in the largest sense the application of science to the sugar industry in its various details, including soils, manuring, and culture for the sugar-beet and methods of manufacture of sugar. Especial attention is given to analyses of sugar and by-products of its manufacture, fertilizers, and various other technical and agricultural products. These analyses are made at fixed rates, persons not members of the society being charged about one third more than the members. In 1889, 4,630 analyses were made, the receipts for which were $7,045. The remainder of the annual expenditure, $890, was made up from the contributions of members to the society treasury. The working force of the station consists of a director, three assistants, and two other persons regularly engaged, others being employed as occasion calls. Numerous volunteer assistants and other persons also work in the station for the sake of the experience. In 1889 there were twelve such persons, and more than two hundred men, all told, not only from Austria, but from Germany, France, and Russia, have in this way availed

themselves of the advantages the station affords. The periodical and other publications of the society, including the *Oesterreichisch-ungarische Zeitschrift für Zuckerindustrie und Landwirthschaft*, are in large part edited by the station.

(3) *The Austrian experiment station for brewing and malting, at Vienna*, established in 1887, examines materials used in the manufacture of beer, makes scientific inquiries in brewing and malting, and teaches the science and practice of these arts. It was organized and is supported and controlled by an association. Its working force consists of a director, three assistants, of whom one is a chemist and another a physiologist, and two helpers. Regular courses of practical instruction are given, one in malting and investigations of malt, the other in the chemistry of fermentation and on yeast.

(4) *Agricultural-chemical station (for investigation and seed control) of the Agricultural Council of Bohemia.*—This was established in 1877 by the Agricultural Council (*Landesculturrath*) of the Kingdom of Bohemia, primarily for seed control. It also makes analyses of fertilizers, soils, sugar-beets, potatoes, etc.

(5) *Experiment station for alcohol industry of the association for alcohol industry, at Prague.*—This was established in 1881 in connection with the distillery school at Prague. Its general purpose is to advance the alcohol industry by scientific and practical inquiries. Especial attention is given to those things which will be of service to the distilleries located on farms, as distinguished from the establishments for the manufacture of alcohol on a large scale. One part of the work of the station consists in giving courses of practical instruction. The first of these courses, which continued 10 days, was attended by 61 owners and managers of distilleries. The station and school receive $600 per annum from the Government.

(6) *Prince Schwarzenberg chemical experiment station, in Lobositz, Bohemia.*—This was established in 1865 by Prince Schwarzenberg, in the interest of the farming, distillery, sugar, and other industries of his estates. It is an entirely private establishment, but has prosecuted inquiries of general interest, including experiments on the culture of sugar-beets, opium poppy, and tobacco, and especially a long series of soil studies.

(7) *Agricultural-chemical experiment station of Voralberg, at Feldkirch, in the Tyrol.*—This was established in 1875 and has been sustained mainly by an agricultural society and by private individuals, though assistance has been given by the Government. Aside from making analyses of fertilizers, feeding stuffs, and other products, and promoting farm experiments in different places, it prosecutes inquiries and gives courses of instruction in subjects relating to dairying. The station has a director but no assistants.

Besides the above there are 9 regularly organized stations as such in connection with 8 agricultural schools. The most important is the

experiment station at San Michele, in the Tyrol. This station makes laboratory, field, pasture, vineyard, nursery, and orchard experiments; investigates problems relating to the conservation and care of wines and fruits; exercises a control over fertilizers, seeds, and preparations of rennet; and makes analyses for farmers, for which a small fee is charged, unless the results are of general interest or the farmers too poor to bear the expense. It receives $1,500 annually from the Government. The other stations connected with agricultural schools are the seed-control stations at Dublany in Galicia, at Kaaden in Bohemia (1877), and at Neutitschein (1883) and Prerau (1884) in Moravia; the experiment station for wine and fruit culture at Parenzo in Istria (1875), the agricultural chemical station at Neutitschein in Moravia (1886), and the agricultural chemical station at Oberhermsdorf in Austrian Silesia. A station for hop culture was established in 1890 in connection with the school at Staresiolo in Galicia. The work of these stations is generally done in part or wholly by teachers in the schools with which the stations are connected. Stations are about to be established in connection with other schools.

Seven other agricultural schools make examinations of seeds, fertilizers, soils, feeding stuffs, wines, sugar-beets, and factory products and refuse, in some cases without charge, in others for small fees.

The Association for the Advancement of Agricultural Experimenting in Austria, organized in 1884, conducts co-operative field experiments, in which members of the association in different parts of Austria and Hungary participate. The entire expense is borne by the experimenters, who even pay for the seeds and fertilizers furnished by the association.

With the present number of the Record a beginning is made in giving brief accounts of European inquiry in lines in which our stations are working. Extensive as is the work of experimental research in agricultural science in the United States, in Europe it is more extensive, and in many respects more thorough. Experiment stations have now been in operation in Europe for more than 40 years. The number of stations is large, their lines of operation are well defined, and their investigations are well systematized. And besides the experiment stations, the laboratories of universities and agricultural schools are devoting the labor of many eminent men of science in Germany, France, England, and the other countries of Europe to the study of the laws which, operating in the air, the soil, the plant, and the animal, underlie the practice of successful farming. It is interesting to see to how large an extent the questions investigated there are the same as those on which our stations are working, or involve the abstract principles on whose solution the successful work of our stations depends. Methods of inquiry, too, are being elaborated in Europe much more thoroughly than in this country.

The desirability of making the processes and results of European investigations available to station workers and others interested in agricultural science in this country, has long been recognized by this Department and has been urged in its annual reports and other publications. The realization of the plans of this Officein this direction has, however, been unavoidably delayed. Its present resources will only allow of the preparation of abstracts of a few articles from European sources for each number of the Record. It is proposed to select a limited number of the more important European publications in which investigations in agricultural science are reported and from these to prepare brief accounts of such inquiries as are most intimately connected with the work of our stations in certain lines. As experience shows what will best meet the needs of the stations and as larger means are provided for this purpose it is hoped to furnish our station workers with a more adequate and satisfactory review of the European inquiries.

The abstracts of reports of European investigations in the present number of the Record were prepared by Dr. E. W. Allen of this Office, who is devoting himself especially to this line of work.

In the table of contents of the present number of the Record an attempt is made to classify under certain general heads the subjects of the articles in the station publications abstracted. It is believed that this will make the subject matter of the Record more accessible, especially to those interested in particular lines of station work.

It is not always easy to determine in which of a limited number of general categories an article should be put. Many of the experiments recorded in the station publications include observations in different lines, and for this reason any condensed classification of them, such as is practicable in a table of contents, will be more or less unsatisfactory. The thorough analysis of the multitudinous details of the recorded operations of the stations can only be made in an extended index. Such an index was published for the first volume of the Record, and it is intended to follow this up for each succeeding volume.

Volume I of the Record contains abstracts of all the bulletins of 1889 received by this Office from the stations in the United States. The present purpose is to include in the Record abstracts of the annual reports of the stations, as well as of their bulletins. The rule is to publish the abstracts in the order in which the publications are received. Various considerations may, however, make departure from this rule desirable or necessary. The annual reports of the stations for 1889, which it was impracticable to include in the first volume of the Record are now being taken up with the other publications. The varied conditions under which the station publications are issued contribute to

considerable irregularity in the receipt of these publications by this Office. The manner in which the different series of the publications of some stations are numbered makes it impossible for the Office to be sure that it has received all the publications of these stations up to any given date. For instance, inquiry was recently made why a station bulletin issued in the early part of 1890 had not been noticed in the Record. The reply was that the Office was not aware of the existence of that bulletin. The author of the bulletin thereupon sent the Office a copy. It was afterwards discovered that the same station had issued still another bulletin in this irregular series of which it gave no account to this Office until it sent in at the end of the year the list of bulletins it had published during the year. These cases are, however, relatively few. When a volume of the Record is completed it may be taken for granted that substantially all the publications of any station issued up to the date of the last one abstracted have been mentioned in the Record.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

California Station, Bulletin No. 89, December 10, 1890 (pp. 4).

DISTRIBUTION OF SEEDS AND PLANTS, E. J. WICKSON, M. A.—A list of the varieties of seeds and plants which the station is prepared to distribute this season to applicants in its own State. Recipients pay for packing and postage or express, and are expected to report results obtained with the seeds and plants sent.

Colorado Station, Second Annual Report, 1889 (pp. 136).

REPORT OF DIRECTOR, C. L. INGERSOLL, M. S. (pp. 3–16).—An outline of the plan of work in the several divisions of the station in 1889.

REPORT OF AGRICULTURAL SECTION, A. E. BLOUNT, M. A. (pp. 17–21).—As printed, this is a digest by the director of the report submitted by the agriculturist. It relates for the most part to tests for soil variations with corn, wheat, oats, and barley, continued from 1888 (See Annual Report of the station for 1888, pp. 25–55, and Experiment Station Bulletin No. 2, pp. 28–30). Details are not given. There are also brief references to experiments with Polish wheat or Mammoth rye (*Triticum polonicum*), and to several species of weeds which are very troublesome in Colorado.

REPORT OF SECTION OF BOTANY AND HORTICULTURE, C. M. BROSE (pp. 22–45).—Owing to the death of Professor James Cassidy, horticulturist of the station, the report of this section was prepared by the assistant horticulturist. As printed it includes a brief record of the growth of 17 varieties of apples, 6 of pears, 6 of poplars, and 2 of willows; tabulated notes on 85 varieties of grapes, 31 of strawberries, 7 of gooseberries, 6 of currants, 19 of sweet-corn, 47 of peas, 36 of beans, 5 of pumpkins, and 10 of squashes, and brief descriptive notes on 12 varieties of celery; brief accounts of experiments with potatoes, onions, cabbages, tomatoes, and carrots; a statement of the number of varieties of vegetables grown for seed for distribution; and brief references to the insects committing injuries in 1889 in the vicinity of the station, condensed from Bulletin No. 6 of the station (See Experiment Station Record, Vol. I, p. 10).

REPORT OF CHEMICAL SECTION, D. O'BRINE, D. SC. (pp. 46–48).—The station laboratory was opened for work October 15, 1888. From that time up to December 3, 1889, 541 analyses were made by the chemical section of the station. The results of a large share of this work were reported in 1889 in Bulletins Nos. 6–9 of the station (See Experiment Station Record, Vol. I, pp. 10 and 190).

REPORT OF SECTION OF METEOROLOGY AND IRRIGATION ENGINEERING, L. G. CARPENTER, M. S. (pp. 49–76).—The work of this section in 1889 included meteorological observations, studies of evaporation, observations of soil temperatures, and the collection of data regarding irrigation as practiced in Colorado.

Extent of the irrigated area in Colorado.—Preliminary estimates, given in the report, from the data collected by the station and from other sources, indicate that—

The total amount of land under ditch in Colorado at present is not far from 4,500 square miles, or 3,000,000 acres. The amount of land actually irrigated can not be so reliably estimated at present. It is much less than the amount under ditch. From the sections of the State which I have visited, it would be safe to estimate that not over one third of this is under cultivation.

It is interesting to compare this with other countries that have practiced the art of irrigation much longer than we. In France, 400,000 acres are under irrigation. In the valley of the Po, according to Baird Smith, 1,600,000 acres were watered in 1851, and in 1882, according to Deakin (Fourth Progress Report, Royal Commission on Water Supply, Victoria), the amount had doubled. In Egypt, about 7,000 square miles are irrigated, and in India, according to data given by Marsh, in "Man and Nature," there seem to be about 18,000 square miles under ditch. When we remember that the subjugation of the arid region in Colorado has practically been confined to the last 15 years, her progress and relative rank are all the more wonderful, and suggest the energetic development that may be expected in the future.

Precipitation.—The tabulated monthly record of the rain-fall at the station for the years from 1873 to 1889, inclusive, shows an average yearly rain-fall of 13.8 inches. Over 45 per cent of this falls in April, May, and June, and some 72 per cent in the six months from April 1 to October 1. The rain-fall for 1889, as recorded in a table for fifteen different localities in Colorado, varied from 7.3 inches to 14.8 inches.

Temperature and sunshine.—The average temperature for 1889 at the station was 46°; average daily range of thermometer, 29.3°, and the maximum range, 55.5°. The average and daily maximum range of temperature in Colorado is recorded for each month of 1889, and compared with similar data for New York for 1888. A table gives the average per cent of sunshine as recorded at the New York State Station during several years, as compared with the per cent of sunshine for 1888 and 1889 at the Colorado Agricultural College, and for 1889 at the substations at Rocky Ford and San Luis. At the New York Station the average per cent of sunshine for the year was 37, and at the Colorado College in 1889 it was 64.7. Observations made at Fort Collins and San Luis, as stated in the report, to determine the loss of sunshine due to the influence of the mountain ranges in shortening the day, showed

the total loss of sunshine in the year to be 102 hours at Fort Collins and 93 hours at San Luis. A tabular record of the amount of sunshine at three places in Colorado is given for each month of 1889.

Solar radiation.—The intensity of the sunlight as measured by the solar radiation thermometers at the station has been very great. In February the radiation thermometer registered 117° above the thermometer in the shade close by. "On the average, the excess is about 60°. * * * The terrestrial radiation thermometer will average about 7° less than the air thermometer in the instrument house, 6 feet higher. The difference rarely exceeds 15°, though 24° has been registered during the year."

Evaporation.—"Evaporation, in view of the questions arising from water storage, is of considerable importance. Measurements were made on tanks placed in the ground, here and at the substations, and also on tanks floating in the water of reservoirs, canals, and the river. The tanks used for comparison here and at the substations were 3 feet square and 3 feet deep. At this station smaller tanks, to determine the influence of size and of the material composing the tank, were also used. Measurements were made with the hook gauge at 12-hour intervals, during June, July, and August, and once per day in September and October.

"Evaporation depends on a variety of conditions. The amount fluctuates greatly from day to day. Nevertheless, we succeeded in producing a formula for computing the evaporation, which agrees closely with the observed values. The evaporation, as computed for the 5 months from June to November, differs from the observed evaporation by only a quarter of an inch. Our measurements show that the evaporation, as measured on days of storms, is frequently excessive, and consequently measurements made at long intervals give too great an evaporation. The evaporation for the whole year, from our principal tank, is less than 40 inches. At the other stations it has been much greater."

A table gives the monthly evaporation for 3 years (1887–89) at the station, and for 1889 at the two substations.

The observations made on one tank from June 1 to November 1 were submitted to a reduction, and the formula found with the most probable co-efficients, as determined by the method of least squares, is E = .1931 (T-t) (1 + .005 W) where E is the evaporation in inches for 12 hours; T is the vapor tension at the temperature of the water surface; t, the vapor tension of the air; and W, the movement of the wind in miles during the 12 hours. This formula satisfies our observations very closely. The computed evaporation for the 5 months from June 1 to November 1 differs only a quarter of an inch from that observed.

For the evaporation of a whole day the formula becomes, E = .3868 (T-t) (1 + .0025 W). The formula found by Fitzgerald, in his careful experiments at Boston, expressed for 24 hours, would be: evaporation for 1 day = .3984 (T-t) (1 + .0208 W). The close agreement of these co-efficients from investigations carried on under as different circumstances as these were, strengthens the confidence in either formula, and makes it probable that the true value of the co-efficient is not far from 0.39 or 0.40.

Seepage water.—A tabular record is given of the mean rate per second and total discharge from a seepage ditch in the college grounds for about 6 months of 1889, as determined by a measuring weir.

Soil temperatures.—A tabular record of the weekly means of soil temperatures and a monthly summary of the meteorological observations at the station in 1889 are also given.

REPORT OF VETERINARY SECTION, WM. MCEACHRAN, M. D., V. S. (pp. 77–79).—A brief account of observations of the temperature of healthy horses, experiments in the use of purgatives with horses, and observations of the disease of horses and sheep caused by the loco weed (*Oxytropus lamberti*).

REPORT ON APIARY, C. M. BROSE (pp. 80–87).—Owing to the press of other work it was found impracticable to continue the experiments with bees begun in 1888 (See Colorado Station Report, 1888, p. 227, and Experiment Station Bulletin No. 2, p. 35). This article contains brief accounts of methods of wintering bees, and a tabulated statement of the condition of twenty colonies belonging to the station, April 1 and 15 and May 1, 1889. Seventeen of these colonies were wintered in "chaff" hives and the other three were left unprotected.

REPORT OF THE SAN LUIS VALLEY STATION, H. H. GRIFFIN, B. S. (pp. 88–112).—"The San Luis Valley (or Park) is about 120 miles long from north to south, and from 40 to 60 miles in width, and is inclosed by mountains, except on the south. Water for irrigation is principally obtained from the Rio Grande River. It is a region of heavy winter snows, but scant summer rain-fall; of high winds and late frosts in the spring, and early frosts in the fall.

"The station is situated near the Rio Grande River, 7 miles east of the town of Del Norte. It is about 60 miles from the southern State line and has an altitude, approximately, of 7,500 feet. The station farm comprises 200 acres; the soil is a light, sandy, gravelly loam; the subsoil is composed of gravel and cobblestone, and is found at depths varying from 1 to 4 feet." Irrigation is used on this farm.

Brief notes are given on experiments with wheat, barley, oats, rye, corn, buckwheat, peas, red clover, alfalfa, esparsette, German millet, English rye grass, and timothy. Notes, in most cases tabulated, are also given for 20 varieties of peas, 2 of onions, 3 of radishes, 3 of lettuce, 5 of beets, 2 of carrots, 29 of beans, 6 of cucumbers, 13 of musk-melons, 4 of water-melons, 5 of peppers, 10 of squashes, 12 of sweet-corn, 3 of turnips, 3 of ruta-bagas, 13 of tomatoes, and 41 of seedling and 59 of standard potatoes. Experiments begun with orchard and small fruits and forest-trees are briefly reported. A summary of meteorological observations is also given.

REPORT OF ARKANSAS VALLEY STATION, F. L. WATROUS (pp. 113–128).—Brief notes on experiments with varieties of wheat, oats, barley, rye, buckwheat, corn, pears, plums, apples, crab-apples, strawberries, grapes, tomatoes, peppers, peas, beans, sweet-corn, water-melons,

musk-melons, cucumbers, squashes, pumpkins, potatoes, sweet-potatoes, pea-nuts, tobacco, timothy, alfalfa, red clover, field peas, millo maize, and sorghum. A barn 28 by 40 feet, and a building 56 by 11 feet, for tool shop, corn crib, wagon shed, etc., were erected during the year. Other improvements were made on the station farm. The year's experience has indicated that the soil and climate at the station are well adapted to the growth of many kinds of garden vegetables and fruits. The prevalence of high winds in spring in this region makes it desirable to surround gardens with hedges.

"We have succeeded in growing four good crops of alfalfa from the spring seeding. Two crops of red clover have been cut the first year, and a third crop turned over in October for fertilizing. Thirty bushels of corn were raised to the acre with one irrigation, and that was unnecessary, as 4 inches of rain fell within one week after irrigation was finished."

REPORT OF SPECIAL EXAMINING COMMITTEE, D. W. WORKING AND D. BROTHERS (pp. 129–132).—This is by members of a committee of the Colorado State Grange and the State Horticultural Society appointed at the request of the State board of agriculture and is commendatory of the work of the station.

Colorado Station, Bulletin No. 13, October, 1890 (pp. 37).

THE MEASUREMENT AND DIVISION OF WATER, L. G. CARPENTER, M. S. (illustrated).—An account of different devices for measuring the water supplied to patrons of irrigation canals in use in Italy, and in Colorado and elsewhere in the United States. The author confidently recommends the overfall or sharp crested weir as "the form of module which best satisfies the conditions of accuracy." The module of the Canale Villoresi, constructed by Cippoletti, very largely on the basis of the extensive investigations of J. B. Francis, of Lowell, Massachusetts, is described in considerable detail, and "seems to possess the most merits of any known to the writer at present." Tables of the discharge of water over rectangular weirs and over trapezoidal weirs of the Cippoletti pattern are printed at the end of this bulletin.

Connecticut Storrs Station, Second Annual Report, 1889 (pp. 184).

REPORT OF DIRECTOR, W. O. ATWATER, PH. D. (pp. 9, 10).—A brief outline of the work of the station in 1889.

THE ACQUISITION OF ATMOSPHERIC NITROGEN BY PLANTS, W. O. ATWATER, PH. D., AND C. D. WOODS, B. S. (pp. 11–51).—A detailed account of the investigations on this subject, briefly reported in Bulletin No. 5 of the station (See Experiment Station Record, Vol. I, p. 194).

BACTERIA IN MILK, CREAM, AND BUTTER, H. W. CONN, PH. D. (pp. 52–67).—A more detailed account of investigations reported in Bulletin No. 4 of the station (See Experiment Station Record, Vol. I, p. 192).

STUBBLE AND ROOTS OF PLANTS AS MANURE, C. D. WOODS, B. S. (pp. 67–82).—"The investigation upon the amount and fertilizing value of the stubble and roots left behind after the removal of crops, described in the Annual Report of the station for 1888, pp. 28–43 [See Experiment Station Bulletin No. 2, p. 57], has been continued during 1889." The method used in obtaining specimens of stubble and roots for analysis is stated. Twenty-three specimens of cow-peas, timothy and redtop, buckwheat, clover, yellow, blue, and white lupine, horse-bean, soja bean, vetch, and mammoth clover are described. The principal statistics contained in the descriptions of specimens and the results of analyses are given in three tables. The most important of these tables gives the "weight of the valuable ingredients of plant-food left in one acre after the removal of the crop. It includes the work here reported upon, together with observations made elsewhere. For comparison the weights of valuable plant-food contained in a few standard fertilizers are appended to the table." The variability of the samples analyzed in 1889 was very noticeable, thus adding emphasis to the following statement made in the report for 1888: "These facts tend to make uncertain many lessons that might be drawn from these tables; indeed, perhaps the most important fact here brought out is the need of more observations."

The following practical summary is taken from the report: "Clover, cow-peas, vetches, and other legumes have a peculiar power of gathering plant-food, and especially nitrogen, from natural sources. Although they contain much more nitrogen than wheat, oats, and similar grains, they thrive and bring large yields where wheat will not. While their faculty for gathering nitrogen from the stores in the soil, and especially from the air, is not yet explained, the important fact here is that they do gather it and leave a great deal of it in the roots and stubble. Nitrogen is the costliest ingredient of fertilizers. These facts help to explain the economy of clover for manure and why clover is so valuable as a preparatory crop for wheat and other grains. The above-cited facts would seem to imply that the legumes, such as clover, cow-peas, and lupines, are especially valuable for this kind of manuring; that timothy and other grasses stand next; and that the grain crops leave the least amounts of plant-food in roots and stubble."

METEOROLOGICAL OBSERVATIONS, C. S. PHELPS, B. S. (pp. 83–86).—Brief notes on the weather and tabulated monthly summaries of the rainfall during 6 months ending October 31, 1889, from observations made at twenty localities in the State, and of meteorological observations made at the station during 1889 by E. A. Bailey.

CO-OPERATIVE FIELD EXPERIMENTS WITH FERTILIZERS, C. S. PHELPS, B. S. (pp. 87–126).—These experiments were conducted on the same general plan as those of 1888 (See Experiment Station Bulletin No. 2, p. 58), and embraced mainly soil tests and special nitrogen tests.

Moisture of corn.—Determinations are given of the percentage of dry matter in corn (grain and cob) and the number of pounds of ears required for a bushel of shelled corn, in crops from six different localities in the State, and of the percentage of dry matter in corn and corn stover from differently fertilized plats.

Soil test experiments.—An experiment on seven farms in different parts of the State. Each trial comprised 10 tenth-acre plats. Nitrate of soda 160 pounds, muriate of potash 160 pounds, and dissolved bone-black 320 pounds per acre, were used singly on three plats, two by two on three plats, and all three together on one plat; plaster was used on one plat and two remained unmanured. The details of the experiment on each farm are tabulated. "In the majority of cases the largest yields were obtained where complete fertilizers were used. As a rule, however, the best financial returns were not secured from such mixtures."

In four cases the results favored phosphoric acid; in two, potash; and in one other, all three elements seemed to be needed. The results were in several cases very marked, and corroborated those of trials made in 1888 on the same plats. A tabulated statement of the "comparative effects of phosphoric acid, potash, and nitrogen in ninety-six experiments" is also given.

Special nitrogen experiments.—The object of these experiments was to "test the effects of nitrogenous fertilizers in different amounts and combinations upon the growth of the plant, and, inferentially, its capacity to gather its nitrogen from natural sources." To applications of potash and phosphoric acid, alone and together, nitrogen was added in nitrate of soda, sulphate of ammonia, and dried blood, and each of these in quantities furnishing one third (24 pounds), two thirds (48 pounds), and the full ration (72 pounds) required by the average crop of corn per acre. The results of trials on three farms, one of which was at the station, are tabulated.

Nitrogen when used in large quantities has not paid for itself in the increase of corn. In the experiment at Mansfield the yield with mixed minerals was only about 2 bushels less than where 24 pounds of nitrogen were added with the minerals. Where the nitrogen was raised to 48 and 72 pounds, scarcely any additional increase resulted. * * * Many plants readily utilize nitrogen supplied in fertilizers; others, when grown in rotation, get on very well if supplied with small quantities in addition to that of the soil; and still others gather large quantities from the air. From our present knowledge, we must place the corn plant in the second of these classes. Numerous experiments indicate that corn gets along very well and gives fair returns when the fertilizers supplied contain one third to one half the nitrogen removed by the crop. Only in very rare cases is the increase of corn proportionate to the increase of nitrogen, and the consequent cost of the fertilizer.

EFFECTS OF DIFFERENT FERTILIZERS UPON THE COMPOSITION OF CORN, C. D. WOODS, B. S. (pp. 127-178).—These studies of the composition of corn and stover were made in connection with the field experiments described above. Samples were taken from the differently fertilized plats of the experiment of 1888 and 1889 and analyzed. The

results of these analyses and of calculations based on them are stated in tables, which give the composition of the water-free substance of corn and stover, proximate ingredients in corn and in stover per acre, and gain or loss in amounts of each ingredient as compared with the unfertilized plats.

Effect of fertilizers upon the percentage and number of pounds of protein in the crop.—Tabular statements show the maximum, minimum, and average percentages of protein in corn and stover from differently fertilized plats and those receiving no fertilizers; the same from plats with and without nitrogen, the pounds per acre of protein in corn and stover raised on differently fertilized plats, and calculations of the pecuniary gain with fertilizers as compared with no manure, based on the American and the German values per pound of protein, fat, and nitrogen-free extract.

Relation of corn to cob and water.—The ratio of corn to cob in the partly dried sample is given for 81 samples; the ratio of water-free corn to cob and water in the sample at harvest for 71 samples; together with the maximum, minimum, and averages for the whole.

The percentage of water-free corn at harvest in the different samples varies from 45.3 per cent to 64.1 per cent, a range of nearly 20 per cent. This means that in the one case 100 pounds of ears would yield 45.3 pounds of water-free corn or 50.3 pounds of corn with average percentage of water, and in the other case 64.1 pounds water-free or 71.3 pounds corn with average percentage of water. Especial pains were taken to harvest the crop from which these samples were obtained, in dry weather, and probably much greater differences would be noticed in corn harvested in the ordinary manner.

Albuminoid and non-albuminoid nitrogen in corn and stover.—"The albuminoid nitrogen was determined in samples from three of the field experiments of 1888 by the method of Stutzer." In the 28 samples analyzed the albuminoid nitrogen in the corn varied from 90.96 to 100, and averaged 95.26 per cent of the total nitrogen; and that in the stover varied from 74.36 to 100, and averaged 86.44 per cent of the total nitrogen. "The results indicate, as would be expected, a much wider range of non-albuminoid nitrogen compounds in stover than in corn. It does not appear that the fertilizers had any marked effect on the percentage of non-albuminoid nitrogen."

Proximate composition of corn and stover.—The results of analyses given in previous tables are summarized in a tabular statement, showing the maximum, minimum, and average percentage composition of the corn and stover from the plats in eight experiments, and the same data for 81 samples. These averages for corn and those compiled by E. H. Jenkins* are combined in a table showing the average composition of flint corn grown in New England.

Summary.—The author summarizes the results of the experiments as to the effect of fertilizers upon the percentage and total amount of

*Connecticut State Station Report for 1888, p. 92.

protein in the crop, the relation of corn to cob and to water, and the composition of corn and stover, in a few brief statements, among which are the following:

The percentage of protein in the corn and stover was greater with nitrogen than without it, and in general increased with the amount of nitrogen added.

The addition of nitrogen in the fertilizers increased the total amount of protein in the crop, even when it did not increase the number of bushels of corn or pounds of stover per acre. Considering the value of protein for feeding, the use of nitrogenous fertilizers for corn may thus be advantageous, even if the increase of crop is apparently not enough to warrant the use of nitrogen. * * *

The variations in the proximate composition of the corn and stover are very wide. This range is greatest in stover. In corn the proportion of protein varied from 8.9 per cent to 13.3 per cent; of crude fat, from 4.4 to 7.2; of nitrogen-free extract, from 76.9 to 81.9 per cent; of fiber, from 1.2 to 2.4; and of ash, from 1.4 to 2.4 per cent in the dry (water-free) substances. In stover the range of the protein was from 4.1 to 11.3 per cent; of fat, from 1.3 to 2.6; of nitrogen-free extract, from 45.9 to 57; of fiber, from 27.9 to 37.3; of ash, from 4.4 to 9.5, on the water-free basis. The water in the samples at the time of harvest varied from 22 to 30.3 per cent in the corn and from 32.4 to 71.4 per cent in the stover.

Illinois Station, Second and Third Annual Reports, 1889 and 1890 (pp. 18 and 24).

These are by the trustees of the University of Illinois for the years ending June 30, 1889 and 1890, and include brief statements about the buildings, equipment, and publications of the station; a list of the experiments completed or in progress; brief abstracts of the bulletins published in each of the two years; and a detailed statement of the receipts and expenditures. The number of bound volumes and pamphlets in the library has increased from 2,265 in 1889, to 3,034 in 1890; 11,000 copies of each bulletin were printed in 1889–90.

Illinois Station, Bulletin No. 12, November, 1890 (pp. 34).

FIELD EXPERIMENTS WITH OATS, 1890, G. E. MORROW, M. A., AND T. F. HUNT, B. S. (pp. 353–370).—"This article gives a record of experiments conducted during three years, in regard to the quantity of oats to sow per acre, the time and depth of sowing, and the manner of preparing the seed bed; of experiments during two years in sowing oats and spring wheat together; and a test of a large number of varieties of oats.

"It is the aim to report and interpret facts obtained; no prophecy is made with regard to the future. There are no means of determining absolutely that these results will be obtained again. Where, however, substantially the same results have been obtained during two or three years, the probabilities are that in this locality similar methods will in the future give similar results."

Oats, quantity of seed per acre.—"Seven contiguous plats, each 2 by 4 rods, were sown broadcast with Welcome oats at the rate of from 1 to 4 bushels per acre, April 5, 1888, March 27, 1889, and April 2, 1890.

The first two seasons the oats were sown on fall-plowed land and covered with a disk harrow and twice harrowing. The last season a different tract of land was used and the land was plowed nine days before seeding. The land was rolled before seeding, and the oats were covered with a disk harrow and a common tooth harrow." A table gives the results for the three years.

Oats, compact or loose seed bed.—In 1888 oats were sown on three plats, each 2 by 4 rods, as follows: "In plat 1, the oats were sown in fall-plowed land and lightly covered with a disk harrow; the land was then rolled with a heavy garden roller and afterwards harrowed. Plat 2 was cultivated with a disk harrow before sowing; the oats were covered by disking once and once harrowing. Plat 3 was disked three times before sowing, once afterward, and then harrowed." In 1889 the experiment was repeated as follows: "In plat 1 the oats were sown on fall-plowed land and were covered by disking once and harrowing twice. In plat 2 the oats were sown on fall-plowed land and were covered by harrowing twice. Plats 3 and 4 were treated as were plats 2 and 3 in 1888." In 1890 four plats were used as follows: "In plat 1 the oats were sown without previous preparation. In plat 2 the land was disked once before sowing. In plat 3 the land was disked three times before sowing. In plat 4 the land was plowed 4 inches deep just before seeding." The results are given in a table.

Oats, time of sowing.—"Four adjacent plats, each 2 by 4 rods, were sown broadcast, at intervals of one week, from April 6 to April 27, 1888. In 1889 seven plats were sown at intervals of one week from March 14 to April 25. In 1890, twelve plats were sown, two each week, from March 22 to April 28, the duplicate plats being six plats apart. Each season Welcome oats were sown on fall-plowed land at the rate of 2½ bushels per acre, and were covered by use of a disk harrow and the common tooth harrow." The results for 1890 are given in two tables and compared with those for 1888 and 1889 in a third table. The details of the experiments of the first two seasons are given in Bulletin No. 7 of the station (See Experiment Station Record, Vol. I, p. 202).

Oats, depth of sowing.—"For three seasons, April 25, 1888, March 28, 1889, and April 16, 1890, sixty selected berries of Welcome oats were sown in each of twelve rows 10 feet long. The first two rows were covered 1 inch deep and each succeeding two rows 1 inch deeper, rows 11 and 12 being covered 6 inches deep. In 1890, as in 1889, an extra row was sown at each side so that the twelve rows in the test would be under similar conditions." For details of the experiment in 1888 and 1889 see Bulletin No. 7 of the station (Experiment Station Record, Vol. I, p. 202). Results for 1890 are given in one table and compared with those for 1888 and 1889 in another.

Oats, effect of sowing with spring wheat.—In 1889 and 1890 nine plats, 2 by 4 rods each, were sown with Welcome oats and Saskatchewan Fife spring wheat. The results are given in three tables.

Oats, tests of varieties.—"In 1889, 30 varieties of oats were tested by this station and the results reported in Bulletin No. 7 of the station [See Experiment Station Record, Vol. I, p. 202]. These varieties have been tested again in 1890 together with 17 other varieties. * * * Eleven varieties were sown on two plats each. The duplicates were, on an average, about 20 rods apart, so arranged as to give the maximum variation likely to occur on the tract used."

In 1889, in tests of the seed of 28 varieties 93 per cent germinated. In 1890, 87 per cent of the seed in samples from the crop of the previous year germinated, and 93 per cent of the seed in samples of 11 additional varieties. In both years the seed obtained from seedsmen was practically free from impurities.

The varieties tested in 1890 are grouped according to their leading characteristics. The yields in bushels per acre are given in tabular form and illustrated in a diagram. The weight per bushel, height, date of ripening, weight of berries, per cent of kernel, and condition of the grain when cut are stated in a table. There are also notes on the quality of the different varieties, with tabulated data, and on the date of ripening, panicles, color, plumpness of berry, and weight per bushel.

Oats, summary of experiments.—The following summary is taken from the bulletin:

The largest yield of grain was produced from sowing 2½ bushels of seed in 1888 and 1890, and from 3½ in 1889. The average yield was slightly larger when 3½ bushels of seed were sown per acre. Between 2½ and 3½ bushels of seed per acre there was but little difference in yield, and with 4 bushels the yield was not much less.

In 1888 and 1889 a medium loose, and in 1890 a fairly compact seed bed gave the best results. A very compact and a very loose seed bed have uniformly given the poorest results. The unplowed land gave this season better results than the plowed.

The time of sowing has had in these tests a more marked influence on the yield than any other condition. The earlier sowings, with one exception the earliest, have uniformly given the best yields. In these tests sowing prior to April 1 has given decidedly the best results.

The depth of sowing giving the best results has varied from 1 to 4 inches, and has not been the same in any two seasons.

No advantage has been found in sowing spring wheat with oats, either in the total quantity of grain produced or in the quality of the wheat. The percentage of wheat harvested was less than that sown.

In 1890 the so-called dun-colored, rust-proof varieties, Texas Rust-Proof, Texas Red, and New Red Rust-Proof, yielded the best; in 1889 they were among the poorest. Texas Rust-Proof gave the largest yield this season and the smallest yield last season. Giant Yellow French, which gave the largest yield in 1889, yielded indifferently in 1890. Early Dakota White is the only variety which did especially well both seasons.

There was an average of 66.2 per cent of kernel in the berry of the seed, and 71.3 per cent in the crop in 1890. The greatest difference of kernel in any two varieties was 15 per cent in the seed sown and 16 per cent in the crop.

Those varieties which contain the higher per cent of kernel in the seed sown contained the higher average per cent of kernel in the crop, but did not yield quite so well as those containing a less per cent of kernel in the crop.

The earlier-ripening varieties yielded the most grain and the least straw and contained the least per cent of kernel.

On the whole, the open-panicled or branching varieties and the closed-panicled side oats, have yielded equally well.

In 1890 the dun-colored varieties stood first in yield of grain, the black second, and the white third. In 1889 the white varieties stood first and the dun-colored last. The dun-colored varieties contained the largest per cent of kernel.

The yield was not materially affected by the length, plumpness, or by the weight of the berry or the weight per bushel. Those varieties with long, slender, light berries and light weight per bushel contained appreciably the larger per cent of kernel. In other words, those varieties which would have sold best on the market, or, what is less important, would have taken the premium at the fairs, did not yield better than the other varieties and did not have so high a food value.

MILK AND BUTTER TESTS, G. E. MORROW, M. A. (pp. 370–375).—The results of analyses by E. H. Farrington of samples of milk of six Ayrshire, five Holstein-Friesian, five Jersey, and two Shorthorn cows, all pure bred, competing at the Illinois State Fair, are given. The prizes were offered for cows producing the largest amount of butter fat during 24 hours. "In this test quantity of milk proved to be as important as large percentages of fat, the prizes in each case being awarded to the cow giving the largest quantity of milk in her class."

The largest amount of fat was produced by a Holstein-Friesian cow giving 68.25 pounds of milk in 24 hours, containing 2.51 pounds of butter fat.

Three of the Holstein cows gave yields of milk unusually large for a show yard test, averaging almost 65 pounds each, which was more than twice as much as was given by any cow of any of the other breeds. The average milk yield of the five Holsteins was more than twice the average in any of the other breeds. This larger yield more than counterbalanced the lower percentage of fat, so that the average quantity of fat produced by the five Holsteins (1.78 pounds) was greater than that produced by any cow of any of the other breeds and twice the average of either the Ayrshires or Shorthorns. The average percentage of fat, of solids other than fat, and of total solids was lower than in either of the other breeds. * * *

The Ayrshires were remarkably uniform in quantity and quality of milk, the four cows over three years old having but three pounds variation in milk yield, and comparatively little in percentage of fat. The average percentage of both fat and total solids was low.

The Jerseys gave the smallest average yield of milk (21.4 pounds), but showed a high average percentage of fat, of total solids, and of solids other than fat. There was greater variation in the percentage of fat in the milk of the Jerseys than in that of either of the other breeds.

[The six Ayrshires averaged 26.3 pounds of milk, containing 0.87 pound of butter fat, and the two Shorthorns, 23 pounds of milk with 0.89 pound of fat.] The two Shorthorn cows gave milk of almost identical composition, having a moderate percentage of fat and total solids. Their yield of milk was less than that of the Ayrshires and but very little larger than that of the Jerseys.

The general average results, taking the eighteen cows as one herd of mixed character as to breed and age, are interesting and make a creditable showing. An average milk yield of nearly 32 pounds per day, and almost 1¼ pounds of fat per cow, is above the average results obtained in practice. The differences to be found in such a herd are also well illustrated. Four of the cows gave an average of a little over 2 pounds of fat; four others, a little less than three fourths of a pound each. One half the herd gave an average of about 1.6 pounds of fat; the other half about 0.85 of a pound each. * * * If we take the average percentage of fat in the milk of the cows of different

breeds, it will be seen that, in equal quantities, the Jersey milk would have 78 per cent more fat than the Holstein, 68 more than the Ayrshire, and 44 more than the Shorthorn.

An abstract is given of the report of milking trials with thirty-nine cows at the show of the British dairy farmers in London, October, 1890, including the results of analyses of milk of Shorthorn, Jersey, Guernsey, Holstein, Ayrshire, Red Polled, and Dexter Kerry cows.

The daily milk yield of two or three cows varied more than 5 pounds in the two days. In the case of one Shorthorn cow the evening milk showed twice the percentage of fat found in the morning milk. * * * During the progress of this show the English Jersey Cattle Society made a test of churning one day's milk of each of thirteen Jersey cows and heifers. The largest yields were 2.21 and 2.09 pounds of butter. Seven other cows gave more than 1.50 pounds. The largest yield of milk was 43.87 pounds. Of the milk of the first-prize cow 14.28 pounds made a pound of butter. Of that of the cow giving the largest yield of milk, 28.36 pounds were required. The very creditable average result for the thirteen cows and heifers was, 31 pounds of milk, and 1.67 pounds of butter.

Tests made by the station of the morning's and evening's milk from each of thirty-five cows of a herd showed the average per cent of fat in the night's milk to be 3.8, and in the morning's milk 4.2. "Dividing the herd into lots of seven we find one fifth giving an average of 5.35 per cent of fat, while another fifth gave an average of 2.86 per cent of fat—only a little over one half as much." The average quantity of fat produced was 0.45 of a pound, the maximum 1 pound, and the minimum 0.25 of a pound per day. An illustration is given of the errors which may occur in sampling milk when the first and the last portions of the milking are not properly mixed.

CREAM RAISING BY DILUTION, G. E. MORROW, M. A., AND E. H. FARRINGTON, M. S. (pp. 376, 377).—This is a report of progress, the results not being given in detail.

In every case the addition of water caused the cream to rise more quickly than when water was not added; and in all cases the time decreased as the percentage of water increased. When the mixture was equal quantities of water and milk, nearly all the fat secured apparently rose within one hour, or one and one half hours, the volume of cream decreasing after this time. * * * When the water was added to the milk, especially if in equal volume, the cream not only rose more quickly, but the line of separation was quite distinct from the first hour. When no water was added the line of separation was indistinct for several hours. When the milk was set in moderately cool water the fat was more completely separated than when in the air, but here, as in the other case, the dilution with water hastened the rising of the cream and left a smaller percentage of fat.

The skim-milk from the undiluted milk of one Jersey cow, set for 15 hours, contained 0.93 per cent of fat, and that of two Holstein cows, 1.24 and 1.35 per cent, respectively. When an equal volume of water was added to the milk the skim-milk of the Jersey (corrected for the water added) contained 1.21 per cent of fat and that of the Holstein 0.60 and 0.45 per cent, respectively.

These experiments do not make it probable that adding water to the milk is a desirable substitute for setting in cold or ice water. They do suggest that dilution may be helpful if ice or a considerable quantity of cold water can not be secured. They

do not clearly show the influence of a higher or lower temperature of the water added. The more rapid rising of the cream is an advantage, and the dilution and consequent lessened value of the skim-milk is a disadvantage of the dilution method. There is a possibility of being easily misled as to the gain from diluting the milk. The cream not only rises more quickly, but is thinner; that is, contains less fat in a given volume than when no water is added, while the diluted skim-milk will look bluer, and chemical analysis will, of course, show a less percentage of fat in it because of the added water.

THE HESSIAN FLY, S. A. FORBES, PH. D. (pp. 377–380, illustrated).—In view of the very general occurrence of the Hessian fly in 1890, in destructive numbers in parts of Central Illinois, an account of the life history of this insect is given in this bulletin and illustrated in a plate accompanying the article. Breeding experiments at the station have shown "that there may be even four generations which attack the wheat with destructive effect, two in spring and two in autumn. The principal injuries, however, are done by the last autumnal and the first spring generations."

Experiments by the author "to test the possibility that the Hessian fly will breed in wild and meadow-grasses have thus far yielded negative results." The article also contains a summary of the most important general preventive and remedial measures.

CANADA THISTLES, THEIR EXTERMINATION, T. J. BURRILL, PH. D. (pp. 379–387).—In Illinois a law against the Canada thistle has been in force since February 28, 1867. In its present form the law provides that "any board of town auditors or commissioners in counties not under township organization, any city council or trustees of villages, may appoint a 'commissioner of Canada thistles,' who, when appointed, is clothed with proper authority and required to attend to the thorough eradication of every plant of this noxious weed. Prosecutions may be made and fines imposed upon any one neglecting the requirements of, or refusing to obey, the law. The only other weed against which the laws of our State are directed is that known as the cocklebur—act in force July 1, 1879, and applying only to highways." One peculiarity of the thistle in Illinois, Ohio, and Indiana is that it rarely produces seed. The plant is described and accounts are given of experiments in exterminating it on a farm near Mattoon, Illinois, and on a small area on the campus of the University of Illinois.

Kentucky Station, Bulletin No. 31, December, 1890 (pp. 27).

SOME STRAWBERRY PESTS, H. GARMAN (illustrated).—This includes notes on the strawberry leaf blight (*Ramularia tulasnei*, Sacc.), with an account of experiments with fungicides; and briefer notes on the strawberry leaf-roller (*Phoxopteris comptana*, Frohl.), strawberry crown borer (*Tyloderma fragariæ*, Riley), strawberry false worm (*Emphytus maculatus*, Norton), white grubs, June bug (*Allorhina nitida*, Linn.), strawberry root worms (*Paria canella*, Fab., *Graphops nebulosus*, Lec., and *Colas-*

pis brunnea, Fab.), smeared dagger (*Apatela oblinita*, Sm. and Abb.), and tarnished plant bug (*Lygus pratensis*, Linn.), with suggestions as to remedies.

Strawberry leaf blight.—Observations at the station in the summer of 1890 on "two lots of strawberries, one in a heavy, poorly drained soil, the other in a lighter soil with an almost perfect natural drainage, indicated no differences in the amount of injury from blight which could be attributed to differences in soil. It was noticed, however, that rows of strawberries which were exposed to the sun were much more affected by the blight than those in the shade. Experiments with Bordeaux mixture, eau celeste, liver of sulphur, and London purple indicated that the blight can be largely prevented by the use of either of the first two fungicides named, and to some extent by the others. Bordeaux mixture gave the best results. The author recommends that it be used as often as once in two weeks. A list of 47 varieties of strawberries grown on the station farm is given, arranged according to the relative amount of injury from the blight observed on them during the season of 1890.

Massachusetts Hatch Station, Bulletin No. 11, January, 1891 (pp. 22).

CONDITIONS AFFECTING THE STRENGTH OF THE STOMACH OF THE CALF FOR RENNET, W. P. BROOKS, B. S. (pp. 3–8).—A report of an investigation carried on at the station in 1889 and 1890, "with the object of determining primarily the influence, if any, of length of time after eating upon the strength of the calf's stomach as a rennet. * * * It was decided also to note the influence, if any, of age and breed." Calves of different ages and breeds, all grades, were purchased from time to time from farmers in the vicinity of the station, care being taken to ascertain the treatment of each calf previous to the purchase.

Every calf was taken from the farm to the butcher's by the station assistant, who was in all cases present when it was slaughtered, and superintended the taking of the rennet, which was immediately carried, with all its contents (both ends being tied), in a clean covered pail to the laboratory. This work in 1889 was done by Mr. F. S. Cooley, and this year by Mr. F. O. Williams, assistant agriculturists, respectively, in these years. The description of the laboratory management by the chemist, Dr. C. A. Goessmann, is here inserted:

"The rennet, as soon as received, was emptied, turned inside out, and cleaned by placing in a large dish of water and allowing it to float therein for a few moments. In no case was water forced into the stomach, but particular care was taken to perform the washing as gently as possible, to prevent the loss of the delicate lining membrane which contains the curdling principle. The stomachs were then reversed, filled with air to their full capacity and hung up to dry in a well-ventilated room. * * *

"Before the tests were made the rennets were taken down, stripped of fat and worthless parts, and cut into small strips. In this condition they were spread out in a well-ventilated room and allowed to air dry several days.

"The rennet solutions were prepared by the Blumenthal process. In every case the same weight of rennet was taken and the final solution raised to the same volume, great care being taken to secure, as far as practicable, identical conditions in all cases. The results were obtained with fresh whole morning's milk."

The results of the investigation are given in tables which contain the following data for 9 calves slaughtered 1 hour after eating, 12 after 5 hours, 11 after 18 hours, and 2 after 30 hours: breed, age in days, date of slaughter, date of rennet test, per cent of moisture, parts of milk at 37° C. curdled by one part of air-dry and water-free rennet in 10 minutes.

These results indicate a progressive increase in the strength of the rennet due to fasting in the three classes from 1 hour up to 18. The average number of parts of milk curdled by one part of water-free rennet is: after 1 hour's fast, 22,091; after 5 hours, 23,315; and after 18 hours, 25,338. The number of animals which fasted 30 hours is too small to justify any comparison. [Averages are also given for each breed and age. The author is, however, careful to state that] these averages are less satisfactory than they would be were the number of each breed, and of each age in each breed, identical in each of the classes compared, and it was the original intention to continue the work until five animals of each age in each breed had been included; but in view of the fact that the work thus far done indicates chiefly a wide individual variation, apparently without reference either to feeding, breed, or age, it is not deemed best to continue the work. The individual differences within the classes are far greater than the differences between classes.

On similar grounds the results for breeds and for animals of different ages are not entirely satisfactory. * * *

The average amount of milk curdled by one part of water-free rennet (pounds of milk for 1 pound of completely dried rennet) from the animals of the different breeds is as follows: Jersey, 27,945, Holstein, 22,665; Hereford, 20,143; and Shorthorn, 16,348. * * * The extremes for Jerseys are 9,188 and 43,261; for Holsteins, 7,974 and 53,404; for Herefords, 14,663 and 24,731; and for Shorthorns, 11,359 and 21,673. Further, the average for the 5 lowest Jerseys is 17,292; for the 6 highest it is 36,826. * * * The averages for the different ages are as follows: from calves 5 days old, 28,597; 28 to 30 days old, 19,057; 35 days old, 19,084; 42 days old, 20,558. The range for these ages is as follows: for calves 5 days old, 11,359 to 53,404; 28 to 30 days old, 7,947 to 36,549; 35 days old, 14,663 to 24,731; and 43 days old, 9,188 to 34,113. * * *

Conclusions.—(1) Individuality appears to be the strongest factor in determining the strength of the rennet.

(2) Our average results indicate that fasting up to 18 hours increases the strength of the rennet; but the variations in each class are so large that we are not warranted in considering our experiments a proof of the fact.

(3) That breed influences the strength of the rennet has not been established, though averages show a considerable variation which places those compared in the following order: Jersey, Holstein, Hereford and Shorthorn.

(4) The rennet of the calf under 1 week old is apparently stronger than that of an animal 4 weeks or more old.

Treatment of potatoes with lime for the prevention of rot, W. P Brooks, B. S. (pp. 8, 9).—A brief report of an experiment in which potatoes which had been sprinkled with lime were stored in a dry cellar and in a dry granary along with untreated potatoes, from September 17 to December 3. The differences in the amounts of dry and soft rot in the different lots were very small and the experiment was, therefore, rightly deemed inconclusive.

Variety test of oats, W. P. Brooks, B. S. (pp. 9, 10).—Brief notes on 1 year's test of Des Flandres and Jaune de Flandres oats.

COMPARATIVE TEST WITH HAY CAPS, W. P. BROOKS, B. S. (pp. 10, 11).—Brief notes on a single experiment with three kinds of hay caps.

FUNGICIDES AND INSECTICIDES ON THE APPLE, PEAR, PLUM, AND GRAPE, S. T. MAYNARD, B. S. (pp. 12–21).—Insects and fungi were very destructive to fruit in Massachusetts in 1890. "It is the belief of many practical fruit growers and market gardeners that from one third to one half of the entire products of the orchards and gardens of the State are destroyed by insects and fungous diseases."

The experiments reported in this article are in continuation of those recorded in Bulletin No. 7 of the station (See Experiment Station Record, Vol. II, p. 22).

Experiment No. 1—Ammoniacal carbonate of copper and Paris green for apple scab and codling moth.—In preparing the mixture the formula used was "3 ounces precipitated carbonate of copper dissolved in 1 quart aqua ammonia (22° Baumé), diluted with 28 gallons of water and 1 pound of Paris green to 500 gallons of the mixture." This was sprayed on apple and pear trees June 7 and 17, and July 1 and 31, the carbonate of copper solution having been applied alone April 24, and Paris green alone May 17 and 21. A diagram shows the arrangement of the treated and untreated trees. A table gives the results for the apple-trees, the pear trees being left out of account because they fruited very unequally. The foliage on all the trees was seriously injured. On the five treated apple-trees there was an average of 43 per cent of wormy apples, and on the four untreated trees, 84 per cent. The fungicide does not seem to have produced any effect when thus used in combination with Paris green.

Experiment No. 2—Bordeaux mixture and Paris green for apple scab and codling moth.—The formula used was "6 pounds of copper sulphate dissolved in 16 gallons of water, to which is added 4 pounds of fresh lime slacked in 6 gallons of water. To this mixture add Paris green in the proportion of 1 pound to 500 gallons. * * * Three large apple-trees were selected that had blossomed abundantly, and one half of each tree was carefully treated. Several applications were made, beginning May 29, at intervals of about 2 weeks."

A table gives the results, which were inconclusive.

Experiment No. 3—Amount of injury to foliage of apple-trees by Paris green—The ammoniacal carbonate of copper mixture, with 1 pound of Paris green to 200, 300, 400, or 500 gallons of the mixture, was applied on four apple-trees, the copper solution without Paris green on one tree, and two trees were used as checks. The results are stated in a table. The injury from the codling moth was reduced by the Paris green from 70 per cent to 29 per cent, but no beneficial results were obtained from the fungicide. Where 1 pound of Paris green to 500 gallons of liquid was used little injury to foliage was observed, but the amount of injury increased with the amount of Paris green applied.

Experiment No. 4—Kerosene and sulphate of copper for the plum wart.—Kerosene having been found in previous experiments at this

station to be an effective remedy for the plum wart (*Plowrightia morbosa*) it was tried on a larger scale in 1890, with good results.

In its application we have found that, unless used with great care, the smaller branches were destroyed. The past season we have overcome this difficulty by applying the kerosene mixed with some pigment to form a thin paste so that it would not spread over the branches. * * *

To be effectual this application must be made as soon as the wart begins to enlarge, which is shown by a swelling on or under the bark, generally of a light brown color when the bark first bursts open, but becoming darker as it increases in development.

The kerosene paste is best applied with a small, pointed paint brush, and should be used on the wart only.

Examination of the trees must be made at intervals of from 2 to 4 weeks, according to the state of the weather.

If the weather be dry and clear few warts will be started, while if moist and warm they develop more abundantly.

In the hope of finding some method of destroying the warts which would require less labor, sulphate of copper (1 pound to 22 gallons of water) was sprayed on plum-trees April 19; sulphate of copper with Paris green (1 pound to 500 gallons), May 17; Bordeaux mixture and Paris green six times, from May 21 to July 29.

Owing to the destruction of the fruit and the foliage by the first application [where Paris green was used], positive results could not be determined as to the effect of the Paris green upon the curculio, but in the case of trees that were treated with the Bordeaux mixture and Paris green only, a very large crop of fruit was matured, while other trees not treated lost all their fruit from the attacks of the curculio. The number of warts was very decidedly less where treated with the copper mixtures than where untreated.

One thing our experiments have demonstrated beyond a question, *i. e.* that plum-trees, leaves and branches, may be kept covered with mixtures of sulphate of copper, lime, and Paris green, for nearly the entire season without noticeable injury and we believe that both the plum wart and plum curculio may be held in check by this remedy. Another season it is hoped that experiments may be made on a large scale in different localities throughout the State, to settle the question.

Experiment No. 5—Bordeaux mixture for grape mildew and rot.—In the station plats are planted two vines each of about 100 varieties of grapes. Of these vines, one of each variety was treated and the other left as a check vine. Some of these varieties have not fruited, but 42 that produced fruit in sufficient quantity for comparison are mentioned in a table, with data as to time of ripening, color, and quality of fruit, and the effect of treatment on mildew. The canes were painted with a strong solution of sulphate of copper, April 2 and 3, and sulphate of copper (1 pound to 22 gallons water) was applied May 29.

Soon after this application it was found that the foliage was seriously injured, and the next application, made June 20, was of the Bordeaux mixture. As the rose-bugs were beginning to work, 1 pound of Paris green to 500 gallons of the mixture was added to this, and other applications were made July 19 and 28. The Paris green had no effect upon the rose-bug, and hand picking was resorted to to save the crop, but the effect of the Bordeaux mixture was so marked that at a long distance it was visible, not only preventing the mildew on the leaf, but the rot of the berry, to which some varieties are almost invariably subject.

At the time of ripening the berries were badly stained with the copper, but analysis showed that the amount was not sufficient to render the fruit unwholesome.

Massachusetts Hatch Station, Meteorological Bulletin No. 24, December, 1890 (pp. 4).

This includes a daily and monthly summary of observations for December, 1890, made at the meteorological observatory of the station in charge of C. D. Warner, B. S.

Mississippi Station, Second Annual Report, 1889 (pp. 44).

REPORT OF DIRECTOR, S. M. TRACY, M. S.—*Cotton, test of varieties* (pp. 8–12).—"Twenty-five varieties were planted to test comparative yields and values of staples. The soil selected for this work was in a broad ravine where the land had been 'made' by washings from the adjoining hills. This land had been in constant cultivation for at least 8 years, but, so far as can be learned, without the application of fertilizers." The cotton was planted April 13, 1889. "No fertilizers were used. A very full stand was secured and no replanting was necessary. On May 20 the plants were thinned so as to stand 18 inches apart in the rows, and during the season the plants were plowed five times and hoed twice. The crop was ginned with a 'Gullett' gin, and samples of each variety were submitted to the 'Arbitration Committee on Classification' of the New Orleans Cotton Exchange, to whom the station is indebted for classification and remarks given in the table" accompanying the report, which also contains data for the yields of lint and seed for each variety, and the "value per acre" based on the market price of similar grades in the New Orleans market January 21, 1890.

The average yield of seed cotton per acre was 975.5 pounds, of lint cotton 301.9 pounds, and the average of lint to seed cotton was nearly 31 per cent.

Truitt's Premium gave the largest yield of lint per acre, 396.3 pounds; Dixon's Improved the largest yield of seed cotton, 1,320 pounds, but only 352.2 pounds, or 26.5 per cent, of lint; Peterkin gave the largest yield of lint per 100 pounds of seed, 39.3 pounds, but made only 287.5 pounds of lint per acre; Okra and Champion Cluster were classed as good middling, while the others were classed as middling, or below; but the yield of Okra was 294 pounds of lint per acre, and of Champion Cluster only 157.6 pounds, and the higher price at which these are valued does not compensate for their smaller yields.

The value per acre of the six varieties succeeding best were—

Truitt's Premium	$40.62
Ferrell's Prolific	40.49
Jones's L. S. Prolific	39.48
Excelsior	37.67
Dixon's Improved	36.20
Truitt's Improved Prolific	35.20

Brief descriptive notes are given for each variety tested.

Cotton, field experiments (pp. 12–14).—Experiments with various fertilizers applied to Allen cotton on worn-out clay soil were attempted, but, owing to causes stated in the report, proved inconclusive. Experiments in "topping" cotton and in deep and shallow cultivation are briefly reported.

Cotton worm, Paris green as an insecticide (p. 14).—Dry applications of Paris green (by means of sacks fastened to the ends of a short pole) proved an effective and inexpensive remedy for the cotton worm (*Aletia argillacea*).

Corn, test of varieties (pp. 14–17).—Tabulated data for 44 varieties. The test was made on land similar to that used in the test of varieties of cotton. "Landreth's Early Summer yellow flint was the first to ripen, the crop being ready to gather July 10, and the yield being at the rate of 22.2 bushels per acre." The six varieties giving the largest yields per acre were, Mosby 71, St. Charles White 66, Parish White dent 54, Improved Leaming 52, Welborn's Conscience 51, and Piasa King 51 bushels.

The average yield of the white varieties was 44.6, of the colored varieties 37.1, of the flint varieties 18.2, and of all the varieties 36.7 bushels per acre.

Corn, field experiments (pp. 18, 19).—Experiments with various fertilizers applied to Evans corn, a large yellow variety, on worn-out upland soil, are briefly reported, but owing to the unevenness of the soil are not considered conclusive.

Sorghum, test of varieties (pp. 19, 20).—Twenty-five varieties were tested "on thin clay upland, which had not been in cultivation for several years."

The heaviest yield of stripped and topped cane was from the Honduras, which gave 11 tons per acre. The greatest yield of cane sugar, 11.5 per cent, was from the Late Orange, while White African, Improved Orange, Link's Hybrid, and Swain's Early Golden each yielded over 10 per cent of cane sugar, besides from 2.66 to 4.80 per cent of glucose.

Sugar-cane, fertilizer experiment (pp. 20, 21).—Experiments with various fertilizers applied to ribbon cane are briefly reported, the results being inconclusive.

Forage plants (pp. 21–36).—Brief notes on experiments in 1889 with some ninety species of grasses, clovers, and other forage plants.

Cattle feeding (pp. 36, 37).—Brief accounts of the results of feeding experiments with milch cows and steers.

Charbon (p. 37).—A brief note on investigations which were afterwards reported in Bulletin No. 11 of the station (See Experiment Station Record, Vol. II, p. 159).

Horticultural work (pp. 38, 39).—For experimental purposes the station has planted "65 varieties of apples, 23 of pears, 97 of peaches, 86 of grapes, 33 of strawberries, and a considerable number of other fruits;

but none of these are yet in bearing." Fertilizer experiments on apples and strawberries are in progress. Experiments with reference to the expense of drying apples and corn are briefly reported.

Chemical work (pp. 39–42).—Tabulated results of analyses of 26 samples of fertilizers are reported.

The work of the chemist has demonstrated very clearly the extensive frauds which are being practiced in the sale of commercial fertilizers, and which are rendered possible by the absence of any law for the protection of purchasers against dealers doing business outside of the State. The chemist informs me that, of the samples sent him by farmers during the past year, not one has come up to the minimum content claimed by the manufacturer, or to the minimum found in the sample sent by the manufacturer to the State chemist for analysis. It is hoped that the present State legislature will take steps to remedy this evil.

REPORT OF METEOROLOGIST, J. M. WHITE, M. S. (p. 43).—A tabulated monthly summary of observations made in 1889.

Nevada Station, Second Annual Report, 1889 (pp. 8).

REPORT OF DIRECTOR, LE R. D. BROWN, PH. D.—This is for the year ending June 30, 1889, and includes a brief outline of the work of the station.

New Hampshire Station, Bulletin No. 10, March, 1890 (pp. 11).

CO-OPERATIVE FERTILIZER EXPERIMENTS, G. H. WHITCHER, B. S.—A report is given of a co-operative experiment on ten farms, the object being "to determine, by field tests, the relative proportion of nitrogen, phosphoric acid, and potash which should form the most perfect crop ration for the soils and crops experimented on." Each separate experiment was made on 20 twentieth-acre plats. The fertilizers used were dissolved bone-black, muriate of potash, and sulphate of ammonia, used singly, two by two, and all together on 12 plats; ashes, barn-yard manure, and a "prepared fertilizer," each on one plat, and on one plat, the manuring of which was left to the discretion of the experimenter, soluble Pacific guano, Quinnipiac fertilizer, Bradley's XL, and Stockbridge's potato manure, were each used in one case, hen manure in two cases, and ground bone and ashes together in one case. Four plats received no fertilizer. The plan was to apply these different fertilizing materials, except the barn-yard manure, in such quantity that the cost of the fertilizer for each plat would be 50 cents; the cost of the barn-yard manure is roughly estimated at $1 per plat. The crop raised was in seven cases corn, in one case corn for silage, in one sweet-corn, and in one potatoes. "While the results can not be regarded as perfect, in fact fall far short of that, nevertheless it is believed that they are valuable."

The tabulated data includes the kinds and amounts of fertilizers used; the yield of crops on each plat; a comparison of the results with manure, "prepared fertilizer," and chemicals; composition of the fertilizers giving the best results; increased yield over the unfertilized

plats; and the value of the same, allowing 25 cents per bushel for shelled corn and $5 per ton for stover. The author's conclusions are as follows:

(1) Chemicals when properly mixed can fully take the place of farmyard manure as a source of plant food. This is shown by the averages of the best plats in each set. (2) Chemicals when properly mixed can and do give greater increase of crop than commercial fertilizers. (3) The average chemical composition of fertilizers for New Hampshire should be phosphoric acid, 9 to 11 per cent; potash, 9 to 15 per cent; nitrogen 2 to 4 per cent; whereas the fertilizers offered to us in the market average, phosphoric acid, 11 per cent; potash, 2.5 per cent; nitrogen, 2.5 per cent."

The author advocates home mixing of crude chemicals, and reprints the formulas of fertilizers for corn, wheat, oats, hay, and potatoes given in Bulletin No. 6 of the station.

New Hampshire Station, Bulletin No. 11, November, 1890 (pp. 14).

RESULTS OF FEEDING SKIM-MILK AND CORN MEAL VERSUS CORN MEAL AND MIDDLINGS, G. H. WHITCHER, B. S. (pp. 3–10).—The experiment was made to compare the financial results of the use of skim-milk and wheat middlings in fattening young pigs. "Within our State to-day there are probably 100,000 cows, producing 300,000,000 pounds of milk, of which about three fourths, or 225,000,000 pounds, is made into butter. Now, on an average, we get not far from 80 per cent of the whole milk as skim-milk; consequently the annual quantity of skim-milk that the farmers of New Hampshire have to dispose of is 180,000,000 pounds, and if this is worth 25 cents per hundred it represents a value of $450,000."

Six pigs, grade Chester Whites, about six weeks old, were divided into two lots nearly alike in total live weight. During a preparatory period of 10 days they were all fed on skim-milk. At the end of that time the total live weight of the three pigs in lot 1 was 96.5 pounds, and those of lot 2, 106 pounds.

The two rations were so made as to contain like amounts of digestible dry matter; one was composed of 1 part by weight of corn meal to 2 parts of skim-milk, and the other of equal parts by weight of corn meal and wheat middlings. The feeding extended from September 3 to January 14, 133 days, and was divided into five periods, the first three of which were of 21 days duration and the remaining two of 35 days.

During the first period lot 1 was fed the skim-milk and corn-meal ration and lot 2 the mixed-grain ration. In the second period lot 1 was changed to the mixed-grain ration and lot 2 to the skim-milk and corn-meal ration; and so on throughout the experiment, alternating the two lots from the skim-milk and corn meal to the mixed-grain ration, and *vice versa*, at the beginning of each period, the change being an immediate one. The amount of each of the two rations fed daily was through-

out the experiment so regulated as to contain 0.53 to 0.54 pound of albuminoids and amides, and 3.33 to 3.36 pounds of carbohydrates and fats for each 100 pounds of live weight, and was calculated at the beginning of each week "not on the actual weight at the commencement of the week, but upon an estimate of what each lot would weigh at the end of the week. * * * As a matter of fact, therefore, the quantity of food was always figured for a greater weight than actually existed." The daily amount of food given and water drank, gain in live weight, cost of gain per pound (allowing 25 cents per 100 pounds for skim-milk, $20 per ton for corn meal, and $26 for middlings), digestible dry matter consumed per 100 pounds of increase in live weight for each lot by periods, and the average cost per pound of growth for each lot on each of the two rations, are given in tables.

The following brief summary gives the averages for the 133 days of the trial:

Gain per week, cost per pound of gain, and dry matter consumed.

	Skim milk and corn-meal ration.		Mixed-grain ration.	
	Lot 1.	Lot 2.	Lot 1.	Lot 2.
Average weekly gain for 100 pounds of live weight ....pounds.	11.3	12.5	9.2	8.5
Average cost of 1 pound of increase in live weight............cents..	3.9	3.4	5.1	5.3
Average amount of digestible dry matter required to produce 100 pounds of gain in live weight ....pounds..	242.0	220.5	334.5	334.5

It is at once seen that the rate of gain is unmistakably greater on the skim-milk and grain than on the grain alone, * * * while the cost of growth in lots 1 and 2 is 1.2 cents and 1.9 cents greater per pound when the food was mixed grain. On grain alone there was a loss of more than 1 cent for every pound of growth. * * * The cost of growth and the amount of food required to produce 100 pounds of growth increase as the pigs grow older, and it would have been much more profitable to have sold them when averaging 175 pounds each than when averaging 240 pounds.

A calculation of the money value of the skim-milk made "by determining the value of the gain for each skim-milk period and subtracting therefrom the cost of the corn meal which was fed with the skim-milk," indicates that "with thrifty pigs from 20 to 30 cents per hundred ought to be and can be realized for skim-milk when live hogs sell at 4 cents per pound. It must be constantly kept in mind, however, that they must be sold by the time they reach a live weight of from 200 to 230 pounds."

Determination of the digestibility of rations, F. W. Morse, B. S. (pp. 11–13).—For the purpose of determining the comparative digestibility of the two rations, one pig was fed on the skim-milk and corn-meal ration (1 part by weight of corn meal to 1.83 parts of skim-milk), and another pig on the mixed-grain ration (equal parts of corn meal and middlings), the excrement being collected for seven days in each case. The average composition of the excrement from each pig, the amounts of each constituent of the two rations consumed, voided,

and digested, and the co-efficients of digestibility are stated in tables. "The nutritive ratios calculated from the actually digested nutrients vary but slightly in the two rations, being 1 to 6.17 for the corn meal and middlings, and 1 to 6.27 for the corn meal and skim-milk."

CONCLUSIONS FROM THE EXPERIMENT, G. H. WHITCHER, B. S. (p. 14).—Among the conclusions drawn by the author are the following:

One hundred pounds of digestible matter in the skim-milk and corn-meal ration were equal to 146.6 pounds in the corn-meal and middlings ration.

The superiority of the skim-milk ration is due in part, doubtless, to its greater digestibility; but still more, in my opinion, to the fact that there is less waste matter, that is, indigestible matter, to be carried through the system, and to the noticeable difference in the character of the dung. The pigs on mixed grain invariably grew constipated, while those on skim-milk were not so affected.

The cost of a pound of gain on skim-milk and corn meal was 3.6 cents; on mixed-grain ration, 5.2 cents.

Digestible dry matter required to produce 100 pounds of gain of live weight on skim-milk and corn meal, 231 pounds; on mixed grain, 334.5 pounds.

New Jersey Stations, Bulletin No. 75, November 7, 1890 (pp. 34).

INSECTICIDES AND HOW TO APPLY THEM, J. B. SMITH.—This contains brief, popular accounts of the different stages of insects, the ways in which they attack plants, methods for applying insecticides, and various kinds of spraying machines.

The preparation of a number of different kinds of insecticides is also described and a record is given of experiments with some of these insecticides by the author and others in 1890. *Potash salts.*—Kainit (1 ounce to 1 pint of water) was effective against wire-worms, cabbage maggots, and plant-lice, but not so against hairy caterpillars. Muriate of potash was used with less success. *Tobacco.*—A decoction of tobacco was successfully used for flea beetles on potatoes, plant-lice on rose-bushes and chrysanthemums, the wheat louse, the larva of the rose tortricid, and the rose slug, but was not satisfactory as used for the larva of the elm-leaf beetle, hairy caterpillor, rose-chafer, and striped beetle on melon vines. "Nicotinia," a rather coarsely ground tobacco dust, was ineffective when applied on dry plants, but made a somewhat better showing on moist plants. A finely ground tobacco dust prepared by the author was much more effective. The addition of carbolic acid to the tobacco powders increased their efficiency fully 50 per cent. "X. O. dust," which seems to be a mixture of tobacco, carbolic acid, and whiting, was more effective than either of the other tobacco powders and is considered by the author fully equal to pyrethrum as a contact poison to be applied dry. Owing to the difficulty of making the powders adhere they are not likely to prove as effective in ordinary field use as they are in experiments on a small scale. Tobacco dust put into the soil was successfully used in 1890 by Dr. E. F. Smith as a remedy for the peach louse. *Napthaline.*—Experiments with this substance for cabbage and radish maggots, the rose-chafer, and plant-lice, while inconclusive, led

the author to believe that naphthaline will prove a valuable insecticide for some purposes. *Fish-oil soaps.*—A commercial brand of whale-oil soap and a fish-oil soap prepared at the station (formula: Hirsch's crystal potash lye 1 pound, fish oil 3 pints, soft water 3 gallons) was successfully used for plant lice. For ordinary purposes a mixture of 1 pound of soap to 8 gallons of water is sufficiently strong. *Gas-tar and tar-water.*—Tar-water (1 gallon of tar to 2 gallons of water) was unsuccessfully tried "on all kinds of plant-lice and on various larvæ, including the cabbage-worm." In the light of his own experience and that of others the author believes that gas-tar is valueless as an insecticide. *Carbonate of lime.*—Experiments indicated that this is not of much value as an insecticide, but "has a considerable advantage over plaster for mixing with Paris green or London purple." *Eureka insecticide.*—This is a preparation of sulphur and was tried "on all sorts of insects without success, except in the case of the red spider," for which it seems to be a specific. *Sludge-oil soap.*—A few experiments indicated that this is "a powerful insecticide and not injurious to plants." *Paris green or London purple for squash borers.*—Brief reports on experiments by several persons who applied Paris green or London purple to the stems of squash vines, as recommended by Dr. Lintner of New York. The results are inconclusive and further experiments are necessary.

The article also contains brief general notes on the use of the arsenites, kerosene emulsion, pyrethrum, lime, and hellebore as insecticides.

New Jersey Stations, Bulletin No. 76, November 28, 1890 (pp. 31).

SOME FUNGOUS DISEASES OF THE SWEET-POTATO, B. D. HALSTED, D. Sc. (illustrated).—In this bulletin are given the results of recent investigations of certain fungous diseases of the sweet-potato at the New Jersey College Station. The descriptions of the diseases and of the fungi which cause them are clearly made in untechnical language and are illustrated with nineteen figures. More detailed accounts of the investigations in this line will be given in the annual report of the station for 1890.

The diseases described and illustrated are the soft rot (*Rhizopus nigricans*, Ehr.), black rot (*Ceratocystis fimbriata*, E. and Hals.), soil rot (*Acrocystis batatæ*, E. and Hals.), stem rot, white rot, dry rot (*Phoma batatæ*, E. and Hals.), sweet-potato scurf (*Monilochætes infuscans*, E. and Hals.), leaf blight (*Phyllosticta bataticola*, E. and M.), leaf mold (*Cystopus ipomϾpanduranæ*, Farl.). The following summary is taken from the bulletin:

Soft rot is caused by a mold that grows with great rapidity in the roots, and is usually most destructive to the sweet-potatoes shortly after digging time, while the roots are passing through the condition known as "sweating." The chief and effective preventive is at this time to keep the potatoes in a well-ventilated, dry room, maintained at the temperature of about 70° by means of artificial heat; watch for and remove any decaying roots, as the fungus quickly passes from one potato to

another, especially if bruised, cut, or broken. This last suggests a further precaution of handling and marring the roots as little as possible.

Black rot is caused by a mold that may enter the sprout from the mother root in the hot-bed and thus transmit the trouble to the potatoes of the next generation. It is also possible for the germs to remain for a considerable time in the soil, and the rot to enter the roots directly therefrom. When once in the potato, it spreads through it, embittering and blackening the tissue until the whole root is worthless. The greatest precautions should be taken that only healthy roots are used in the hot-bed, and that all sprouts showing any signs of blackening of stem or young leaves be discarded. Field experiments in the future may lead to a direct remedy that may be applied to the plants or the soil, or both.

Soil rot is due to the invasion of a fungous growth that attacks the roots through their small lateral fibrils, usually when quite young, and not being able to spread throughout the whole root, the further development of the infested potato may cause a partial obliteration of the disease. Plants badly attacked are not able to produce vigorous vines, and the roots, while often numerous, are mostly small and unmarketable The fungus produces vast numbers of spores in the diseased tissue, and this becoming dry and powdery, the germs are largely left in the soil, where they probably retain their vitality for a long time, and serve to inoculate the roots of the first sweet-potato plants that are set upon the infested soil. The use of healthy sprouts does not insure the crop from the fungus, and therefore remedy must be sought in ridding the soil of the germs or preventing them from entering the young roots. The growing of other crops upon an infested soil for a term of years, while at a present comparative loss, is one of the most practicable methods of clearing the land. It is possible that the fungus feeds upon other plants than the sweet-potato—a condition of things suspected from an examination of the roots of several weeds growing among the potatoes. Further field experiments need to be made before definite results as to application of remedies to the soil can be recommended.

Stem rot.—Upon this the investigations were begun too late to obtain the first stages of the disease. Several kinds of fungous growths have been met with, one or more of which may have been the cause. The young roots begin to decay near the top, the rot descending usually for only an inch or so, during which time new sprouts grow from below, but to no purpose.

White rot is associated with a blue mold that, beginning at the base of fine hairs, produces small but slowly deepening and broadening pits, until the whole root may be changed into a dry, chalky, worthless substance. As yet this form of rot is not common.

Dry rot is another decay of the "sweets" of fungous origin, in this case not changing the exterior color, but transforming the substance into a dry, yellowish mass, with pimples upon the surface, in which the spores of the parasite are produced in great numbers. Fortunately this trouble is as yet not serious.

Scurf is a well-known superficial appearance of the potato, due to a dark mold that grows in the surface cells of the root, and afterwards sends up dark spore-bearing stalks. While reducing the market value of the potato the mold does not cause a destruction of the root, and therefore is not an occasion for any alarm.

Leaf blight is the name of a trouble due to a fungus that confines its work to the leaves, where it produces dead spots in the foliage, and thereby weakens the plant to an extent proportional to the amount of spotting.

White mold is more troublesome in New Jersey than the leaf blight, as it ruins the older leaves, which turn brown and die. It, however, in contrast with soil, black and soft rots, is a comparatively harmless enemy.

New Jersey Stations, Special Bulletin K, February 28, 1890 (pp. 43).

THE INSECTS INJURIOUSLY AFFECTING CRANBERRIES, J. B. SMITH (illustrated).—This includes a review of field notes made by the author in 1889, and illustrated accounts of the following insects, with suggestions as to remedies: the black-headed cranberry worm (*Rhopobota vacciniana*, Pack.), yellow-headed cranberry worm (*Teras vacciniivorana*, Pack.), cranberry fruit worm (*Acrobasis vaccinii*), tip worm (*Cecidomyia vaccinii*, Smith), cranberry scale (*Aspidiotus*, sp.), grasshoppers, locusts, and cranberry leaf hoppers.

The bulletin is illustrated with 26 figures, of which 18 are original. Reference is made to previous studies by the author on insects infesting cranberries in New Jersey and Massachusetts, published in Bulletin No. 4 of the Division of Entomology of this Department, and in the Annual Report of this Department for 1884.

New Mexico Station, Bulletin No. 1, April, 1890 (pp. 4).

GENERAL INFORMATION REGARDING THE STATION, H. HADLEY, M. A.—The Territorial legislature of New Mexico at its session of 1889 established an agricultural college at Las Cruces and connected with it an experiment station in accordance with the provisions of the act of Congress of March 2, 1887. The citizens of Mesilla Valley donated to the college and station a farm, part of which was in cultivation according to primitive methods, while the rest was virgin soil. As irrigation must be largely used here it will require much labor to prepare the farm for experimental uses. "A portion of the farm is mesa land lying above irrigation level, and was covered with the native mesquite and tornillo. For ages it has received but the scanty rain-fall of arid regions. This portion has been cleared of its rubbish, and reveals a soil of apparently great fertility.

"Water can be had at a depth of 50 feet, and we are now sinking wells and putting in hoisting apparatus, hoping soon to show, on a small scale to be sure, the superior quality of the soil. The farm has been substantially fenced, some irrigating ditches constructed, much leveling done, and buildings are now being erected for the accommodation of the station. The land is being tilled to common crops to bring it 'into subjection.' This is all preparatory work, but it is necessary work."

Attention is called to the peculiar conditions existing in New Mexico because of its great area and varying elevation and the great variety of its soils and climates. This station evidently has before it a large but exceedingly interesting task to aid in developing the agricultural possibilities of this region.

New Mexico Station, Bulletin No. 2, October, 1890 (pp. 6).

THE WORK OF THE STATION, A. E. BLOUNT, M. A.—A large, two-story brick building, containing nine rooms, is in process of erection for the use of the college. In addition to the work on the farm, mentioned in Bulletin No. 1 of the station, 45 acres have been prepared for experiments in the propagation and cultivation of fruit and shade trees, nursery stock, vegetables, and grains. Plans are being made for the establishment of a grass garden and for the building of irrigation reservoirs to be filled from wells. Twenty acres will be devoted to experiments with orchard and small fruits, grapes, nuts, shade trees, sugar-beets, and potatoes. Varieties of wheat, corn, oats, barley, rye, buckwheat, sorghum, grasses, clovers, millets, and other forage plants will be tested. Various methods of irrigation, tillage, and rotation will be tried.

The mistletoe (*Phoradendron juniperinum*) and the dodder (*Cuscuta trifolii*) are very troublesome in this region. The insects which committed the most serious depredations during the season of 1890 were the June bug (*Lachnosterna fusca*), twig girdler (*Oncideres cingulatus*), squash bug (*Coreus tristis*), vine hopper (*Tettigonia vitis*), and the woolly aphis (*Aphis lanigera*).

New York Cornell Station, Second Annual Report, 1889 (pp. 24).

This includes brief reports by the director, treasurer, chemist, botanist and arboriculturist, cryptogamic botanist, entomologist, agriculturist, and horticulturist, outlining the work of the year in the different departments of the station.

The following observation by the director on the kind of labor necessary to the success of station work is worthy of note: "It was early found that untrained laborers were illy suited to perform even the most common operations of experiment work without careful and constant supervision. So, for the sake of both economy and accuracy, the common laborer has been largely dispensed with, and the work has been performed by the salaried assistants."

The fact that "there are not less than 500,000 adult men in the State who are directly engaged, to a greater or less extent, in growing animals and plants," has made it necessary for the station to depend very largely on the agricultural press for the dissemination of the results of its work, and the liberal and kindly aid which has been extended to the station by the press is gratefully acknowledged in the report of the director.

New York Cornell Station, Bulletin No. 23, December, 1890 (pp. 26).

INSECTS INJURIOUS TO FRUITS, J. H. COMSTOCK, B. S., AND M. I. SLINGERLAND (pp. 103–126, illustrated).—Notes on the pear-leaf blister (*Phytoptus pyri*), a stag-beetle borer in the pear (*Dorcus parallelus*),

apple bucculatrix (*Bucculatrix pomifoliella*), cherry-tree tortrix (*Cacœcia cerasivorana*), cherry-tree scallop-shell moth (*Hydria undulata*), a leaf roller on the currant (*Cacœcia rosana*), a blackberry cane-borer (*Oberea bimaculata*), and the snowy tree-cricket (*Oecanthus niveus*).

Pear-leaf blister.—A disease of pear leaves observed in Western New York has been found to be caused by *Phytoptus pyri*. Reference is made to accounts of this disease by Burrill and Sorauer. The symptoms of the disease, structure of the leaf gall, appearance of the mite, and its life history are described and illustrated. The authors found the number of rings on the body of the insect to be much greater than is stated by Sorauer. Experiments with kerosene emulsion as an insecticide for this mite gave only negative results. Pruning the young wood after the mites have gone into winter quarters in the terminal buds, and burning the fallen leaves and rubbish in the orchard are the only effective means for destroying these insects.

A stag-beetle borer in the pear.—*Dorcus parallelus* was found at Elmira, New York, "in the roots of an old pear tree, where it had eaten off one of the branch roots, which was about 2 inches through, and the tap-root, which was nearly 3 inches through, and was eating upwards in the tap-root when discovered."

The apple bucculatrix.—This pest of the apple is becoming very abundant in some parts of New York. A review of what is known about this insect is given, especial use being made of the results of Dr. Brunn's studies, published in the Annual Report of the station for 1883 (pp. 157–161). Experiments showed that the pupæ in cocoons attached to the larger branches and the trunk may be destroyed by a strong kerosene emulsion.

A small amount of pure kerosene applied in a fine spray killed every pupa; and as the oil evaporated in a few hours, it is quite probable that the dormant wood was not injured. Still, I am unwilling to advise the use of kerosene in this way before trying further experiments. And I believe that a more practicable method of fighting the pest is suggested by the fact that during the greater portion of its larval existence it feeds exposed on the surface of the leaves. If, therefore, the infested trees be liberally sprayed with Paris green water during the latter half of June the larvæ will be poisoned.

The cherry-tree tortrix.—The insect and its nest are described and illustrated. The eggs were not observed, but it is considered probable that they are laid in a cluster near the ends of branches and do not hatch until spring.

As no black currant (the plant upon which the eggs were found) was at hand, the larvæ were placed on the common red currant, where they were perfectly contented. * * * Probably the most practicable method of destroying this insect, should it become a serious pest, would be the careful pruning and burning of the infested leaves and twigs. As the insect is concealed in the rolled leaves during its larval existence, the application of arsenical sprays would probably be of little use.

A blackberry cane-borer.—An account of observations on *Oberea bimaculata* found infesting blackberry canes near Kidder's, New York, in 1888. Infested canes should be promptly cut and burned.

The snowy tree-cricket.—An illustrated account of *Oecanthus niveus*, which caused injuries to the canes of black raspberries, as reported to the station:

This insect is very subject to the attacks of parasites. From a single nest from which we bred only sixteen moths there emerged eighty-seven Ichneumon flies. It is evident that in this case the majority of the larvæ were destroyed by the parasites. This is probably the reason that the species is kept tolerably well in check in most parts of the country.

In case this insect becomes destructively abundant, it can be easily checked by cutting out the nests and burning them before the moths emerge. As the insects reach maturity in July, some of them early in that month, the destruction of the nests should be made not later than the last of June.

The cherry-tree scallop-shell moth.—An illustrated account of this insect, from specimens bred in the insectary of the station. The larva is described in detail. Chalcid and braconid flies were found to be parasites destructive to *Hydria undulata.*

Notwithstanding the number and activity of its little foes, this cherry-tree pest (*Hydria undulata*) has become so numerous in a grove of small trees, mostly wild cherry, near the insectary that during the past summer the beauty of many of the cherry-trees was seriously marred and their growth no doubt considerably checked. The remedy is simple and easily applied. Our experiments in the insectary, supplemented by field observations, indicate that the insect is single brooded in this State, and that most of the larvæ leave the nest during the month of September, so that if the branches containing the nests be cut off and burned prior to September 1, the pest will soon be exterminated.

A leaf roller on the currant.—An illustrated account of the life history of *Cacœcia rosana*, from specimens bred in the insectary of the station.

The eggs hatched during the last days of April (27–28). Some of the larvæ had reached the last larval stage by the middle of May, while others were not more than half grown at this time. The first pupa was observed May 22, and within a week all of the larvæ had transformed to pupæ. The moths began to emerge June 3.

Eggs were not obtained from the moths that we bred, consequently only one generation was observed. It is probable, however, that there are two or more broods each season. The time at which the eggs were found shows that the species passes the winter in this form.

New York Cornell Station, Bulletin No. 24, December, 1890 (pp. 13).

THE CLOVER RUST, J. K. HOWELL (pp. 129–139, illustrated).—Attention is called at the outset to the difference between clover rust (*Uromyces trifolii*) and two other minor diseases of red and white clovers, *Phyllachora trifolii* and *Phacidium trifolii.* "Both of the latter produce black, smoothish discolorations, chiefly of the leaves; while the true 'clover rust' infests the leaves, the leaf stalk, or petioles, and the stems. In appearance the spots of the rust proper are oblong, well defined, brown in color, and somewhat powdery on the surface. The disease has not been long known in America, but has prevailed to such an extent during the several wet, cool seasons preceding 1890, in many sections of the Northern States, that it must be regarded as a disease

likely to affect seriously, under conditions favorable to its development, an agricultural crop."

The relation of clover rust to other forms of rust is briefly discussed. "*Uromyces trifolii* has long been known in Europe on many species of clovers and a few other leguminosæ, but has not attracted the attention of mycologists in America until recently. The form on our cultivated clovers was no doubt introduced within a comparatively few years, but that on certain Rocky Mountain plants may be native."

The "rust" proper was first reported in America in 1884, by Mr. Holway, in the "List of Iowa Uredineæ," compiled by Mr. Arthur.

According to a table given in this article, clover rust has been found in this country from Connecticut to Montana and Utah, and on six species of clover and *Glycyrrhiza lepidota*. In 1888, according to Professor Underwood, it was quite injurious to clover near Syracuse, New York. "The uredo and teleutospore stages (the rust proper) were also noticed near Ithaca in 1888, occurring in great abundance. During the year 1889 all three stages have been found on the red and the white clover, the rust stages so abundant as to destroy, it is estimated, 50 per cent of the second or 'rowen' crop. During 1890 it was far less abundant. Although in the autumn it was plentiful it did not injure the clover to a great extent."

The investigations reported in this bulletin were planned by Professor Dudley and carried on in his laboratory, but, as Professor Dudley states in a foot-note to this article, "the discoveries made and the conclusions reached, and in part stated herein, are the result of the faithful, careful work of the author, who, as time permits, will follow out the incompleted lines of investigation." The fungus in its different stages is described and illustrated, and observations and experiments made at the station are concisely recorded.

Summary.—(1) The parasitic clover rust is chiefly propagated throughout the growing season of the host, by the uredospores, owing to their abundance, rapid germination, and the fact that for the most part they reproduce only their own form of spore.

(2) The germination of the æcidiospores gives rise to uredo sori, thus demonstrating what has heretofore been merely assumed, viz., the connection of the æcidium or "cluster-cup" of clovers with the brown "clover rust."

(3) Both uredospores and æcidiospores prefer a low temperature in germination. [Experiments showed that the former germinated most rapidly at 11–16° C., and the latter at 15–18° C.] This accounts for the fact that during the middle period of the summer of 1890, which was very warm, little of the rust appeared, while more of it was generated during the latter and comparatively cooler months, although at no time did the amount equal that produced during the cool and moist midsummer and autumn of 1889.

The most important questions remaining to be investigated in the life history of the clover rust are its mode of hibernation and the origin of the æcidia. The two questions are closely linked together, and two theories have occurred as possible solutions of them. First, the æcidia may be produced in the spring through the germination of teleutospores which live over winter on the dead clover stems. Second, the uredo and teleutospores may germinate in the fall, form mycelium in

the white clover plants, and survive the winter in them as mycelium and spermogonia. The first mode would seem the natural one for preserving the parasite through the winter; but the small number of germinations [only seven from numerous cultures, and even in these cases development was soon arrested] obtained from the teleutospores taken from the dead stems implies some other mode of hibernation. The second theory is supported by the fact that, in 1890 at least, not only the æcidia, but mainly the uredo and teleutospores also, were found in spring and early summer, occurring mainly on the white clover. The infection of the "rowen" or second crop of red clover evidently took place largely through the generations of uredospores derived from the white clover. Observations along these lines are still going on.

Suggestions.—So far as present observations go:

(1) The early crop of red clover is not likely to suffer injury from the rust.

(2) As the second crop is likely to suffer greatly if the midsummer is cool, and as clover becomes a valuable fertilizer when plowed in, the fields should be carefully watched in such seasons and the crop might be plowed under to advantage.

(3) Burning the clover fields in the fall would probably have some effect in checking the spread of the disease during the next season; but the application of fungicides seems impracticable.

North Carolina Station, Bulletin No. 73a (Meteorological Bulletin No. 12), October 15, 1890 (pp. 16).

METEOROLOGICAL SUMMARY FOR NORTH CAROLINA, SEPTEMBER, 1890, H. B. BATTLE, PH. D., AND C. F. VON HERRMANN.—Notes on the weather, and monthly summaries and a tabulated daily record of meteorological observations by the North Carolina weather service. The bulletin is illustrated with maps of North Carolina, showing the isothermal lines and the total precipitation for different parts of the State.

Rhode Island Station, Second Annual Report, 1889 (pp. 124).

This is published as Part II of the Second Annual Report of the board of managers of the Rhode Island State Agricultural School and Experiment Station, made to the general assembly of Rhode Island at its January session, 1890.

REPORT OF BOARD OF MANAGERS (pp. 3–8).—A brief account of the operations of the station in 1889.

ORGANIZATION, C. O. FLAGG, B. S. (pp. 9–18).—A reprint of Bulletin No. 1 of the station (See Experiment Station Record, Vol. I, p. 145).

THE FARM, C. O. FLAGG, B. S., AND E. F. CLARK (pp. 19–32).—A reprint of Bulletin No. 2 of the station (See Experiment Station Record. Vol. I, p. 146).

STOCK FEEDING, H. J. WHEELER, PH. D. (pp. 33–69).—A reprint of Bulletin No. 3 of the station (See Experiment Station Record, Vol. I, p. 296).

BEE KEEPING, S. CUSHMAN (pp. 70–96).—A reprint of Bulletin No. 4 of the station (See Experiment Station Record, Vol. I, p. 296).

POTATOES, METHODS OF PLANTING AND TEST OF VARIETIES, AND METEOROLOGICAL SUMMARY, L. F. KINNEY, B. S. (pp. 97–104).—A

reprint of Bulletin No. 5 of the station (See Experiment Station Record, Vol. I, p. 297).

REPORT OF DIRECTOR, C. O. FLAGG, B. S. (pp. 105–109).—A brief outline of experiments begun by the agricultural division of the station with fertilizers and various crops.

REPORT OF AGRICULTURIST, L. F. KINNEY, B. S. (pp. 110–114).—A brief account of the work begun at the station with vegetables, small and orchard fruits, and forest-trees.

REPORT OF CHEMIST, H. J. WHEELER, PH. D. (pp. 115–117.)—An account of preliminary work by the chemist of the station, who began his official duties September 1, 1889.

REPORT OF APIARIST, S. CUSHMAN (p. 118).—A brief reference to the needs of this division of the station.

South Dakota Station, Bulletin No. 19, December, 1890 (pp. 28).

THE SUGAR-BEET, L. FOSTER, M. S. A., AND J. H. SHEPARD, M. A.—"The station began its work in the cultivation of the sugar-beet three years ago, the single object of the experiment being to determine if the sugar-beet, containing a per cent of sugar large enough for profitable manufacture, could be grown in South Dakota. Methods of planting, fertilizing, and cultivating came in as secondary matters only, those already established in France and Germany being followed as nearly as seemed practicable for our new soil and higher-priced hand labor. The high sugar per cent being now satisfactorily settled the attention of the station may in the future be directed to the economic production of the crop."

Statements are made to show that the soil, temperature, and rainfall in South Dakota are favorable to the cultivation of the sugar-beet. Methods of soil preparation, fertilizing, planting, cultivation, thinning, harvesting, and storing, as practiced at the station, are given, together with the "official advice of the Oxnard Beet Sugar Company [of Grand Island, Nebraska] to its patrons on the subject of beet culture." There are also notes on the methods used at the station in sampling and analyzing sugar-beets. The varieties tested at the station in 1890 were "Bulteau Desprez's Richest, Dippe's Vilmorin, Florimond Desprez's Richest, Dippe's Klein Wanzleben, Simon Legrand's White Improved, and one variety from the Oxnard Beet Sugar Company." With one exception the seeds came from French and German seedsmen. "The soil used by the station is the ordinary upland sandy loam of the Big Sioux Valley and has been for twelve years under cultivation. A mechanical analysis made by the station chemist is reported."

The ground was plowed to the depth of 11 inches in the spring just before planting. Well-rotted barn-yard manure, at the rate of 24 cubic yards per acre, was evenly distributed on the land the previous fall. The planting was done about the middle of May in rows 30 inches apart. The plants were thinned to 8 inches in the row and were hoed twice and cultivated four times before July 20. To decide when the beets reached

maturity, as indicated by their sugar content, analyses were made from samples of the Dippe's Vilmorin variety, taken at intervals of a few days, from October 9 to 29. The results indicated that the beets reached their best condition for the production of sugar from the 15th to the 20th of October. The following results were obtained from the analysis of samples of the different varieties taken October 22:

Name of variety.	Sugar in whole beet.	Sugar in juice.	Marc.	Degree Brix	Purity co-efficient.
	Per cent.	*Per cent.*	*Per cent.*		
Oxnard	17.85	18.77	4.9	22.60	83.08
Pajaro Valley	14.65	15.36	4.6	20.40	75.29
Simon Legrand's White Improved	15.55	16.34	4.85	20 80	78.56
Florimond Desprez's Richest	13.15	13 67	3.83	17.80	76.80
Dippe's Klein Wanzleben	16.15	16.93	4.58	20 80	81.39
Bulteau Desprez's Richest	14.75	15.42	4.36	19.70	78.27

Analyses of samples taken October 30 were made at the station and at the United States Department of Agriculture. The results as stated in this bulletin are somewhat different from those given above. The results of piling the beets and leaving them for a week in the field with a shallow covering of dry earth, which left. the tops exposed, did not indicate any increase of sugar content from this treatment. A table shows the weights of the individual beets analyzed. The analyses of a number of samples of sugar-beets received from different parts of the State are given, though the data as to methods of cultivation, yield per acre, names of varieties, etc., sent with these samples were in many cases unsatisfactory.

The following is a summary of the results of the season's work:

Variety.	Actual results for 1890.						Computed on 100 per cent stand.	
	No. of analyses.	No. of beets analyzed.	Average weight of beets.	Sugar in beets.	Yield of beets per acre.	Total sugar per acre.	Yield of beets per acre.	Yield of sugar per acre.
			Ozs.	*Per ct.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Lemaire's Richest	3	7	19	15.42	....	....	....	....
Oxnard	4	16	22	16.41	13,000	2,133	42,038	6,898
Pajaro Valley	3	12	25	15.08	20,650	3,114	48,600	7,329
Simon Legrand's White Improved	3	12	21	16.10	14,712	2,369	30,706	4,943
Florimond Desprez's Richest	3	12	24	13.98	16,498	2,306	36,371	5,089
Quedlinberg	5	8	18	13.05	....	....	....	....
Dippe's Klein Wanzleben	8	29	17	14.70	16,400	2,411	38,800	5,704
Dippe's Vilmorin	8	28	20	15.81	14,420	2,284	32,044	5,069
Bulteau Desprez's Richest	3	12	19	16.38	16,311	2,672	42,017	6,880

Little can be said in favor of the ordinary American-grown seed, called by courtesy sugar-beet seed. In fact all tests at this station have shown that they are little better than ordinary mangel-wurzels. We must procure our seed from eminent breeders at first, but our greatest need at present is for reliable American-grown seeds, propagated from pedigreed beets.

The work on sugar-beets will be continued another year by the station, and farmers of the State are urged to co-operate with the station in this line of investigation.

Tennessee Station, Bulletin Vol. III, No. 5, December, 1890 (pp. 22).

FRUIT-TREES AT THE EXPERIMENT STATION, R. L. WATTS, B. AGR. (pp. 75–92).—This includes (1) general observations on the adaptability of Tennessee for fruit growing and the increasing demand for fruits in this country; (2) notes on the varieties of orchard fruits being tested at the station; and (3) general directions for the harvesting, packing, and marketing of fruit. Brief descriptive notes on the fruit and on the condition of the trees growing on the station grounds are given for 44 varieties of apples, 12 of dwarf pears, 25 of standard pears, 33 of peaches, 6 of nectarines, 8 of apricots, 20 of cherries, 28 of plums, and 3 of figs.

Wisconsin Station, Sixth Annual Report, 1889 (pp. 251).

REPORT OF DIRECTOR, W. A. HENRY, B. AGR. (pp. 1–5).—Brief general statements regarding the work of the station.

EXPERIMENTS IN PIG FEEDING, W. A. HENRY, B. AGR. (pp. 6–41).

Effects of dried blood, pea meal, and corn meal on the carcass, bones, and viscera of the hog (pp. 6–13).—This is a continuation of experiments reported in the Fourth and Fifth Annual Reports of the station in which rations rich in carbohydrates and poor in protein were compared with those rich in protein. In the present trial rations consisting of one third dried blood and two thirds corn meal, of equal parts of pea meal and corn meal, and of corn meal alone were each fed to four pigs. All the pigs received in addition to the above rations, hard-wood ashes, salt, and hard well-water. Two of the pigs on each ration were killed after 143 days feeding; the other two, after 149 days.

The composition of the corn meal, pea meal, and dried blood fed is given; and for each lot tabulated statements regarding the gain during the trial, amounts of food consumed, food consumed per 100 pounds of gain, and cost of the same; data relative to the blood, liver, and kidneys; and the analyses of sections of the carcasses. More complete data, including the chemical composition of the viscera, are given in an appendix on pp. 229–232 of the report.

The results indicate that—

A greater weight of corn meal was required for producing 100 pounds of gain than of the other two mixtures; but at the prices named [corn meal $14, pea meal $25, and dried blood $30 per ton] the mixture of peas and corn meal costs the most for the gain produced, the dried blood and corn meal coming second, while the corn meal ration was the cheapest.

Comparing the amount of dry matter in the blood with the dressed weight of the carcasses we find an excess of 7 per cent for the blood-fed and 3 per cent for the peas-fed hogs over those getting corn.

Comparing the weight of the livers with the dressed weight of the carcass we find a difference against the corn-fed hog of over 19 per cent for the blood-fed and 16 per cent for the peas-fed hogs. * * * The kidneys follow the blood and liver in being heavier with the first two lots of hogs than with the last lot. * * *

There was nearly 2 per cent more fat in the kidneys of the corn-fed hogs than in the kidneys of the other two lots. This shows that the fattening process reached even the kidneys.

Figuring with or without the fat there was considerably more dry matter in the kidneys of the first two lots [dried blood and pea meal] than the last lot [corn meal].

Effects of rain-water, well-water, and bone meal on the growth of carcass and strength of bones of pigs (pp. 13–15).—In this experiment rations consisting (1) of corn meal, rain-water (containing 6.44 grains of solids, mostly carbonate of lime, per gallon), salt, and ground bone; (2) of corn meal, rain-water, and salt; and (3) of corn meal, hard well-water (containing 40.46 grains of solids, mostly carbonate of lime, per gallon), and salt, were each fed to two Poland China pigs during 149 days. The results of the trial, which are tabulated "are so irregular that they throw doubts on any conclusions that may be drawn."

It is interesting to note, however, that supplying well-water seemed to give no advantage over rain-water; indeed the results are against well-water in the amount of gain made, the food required for 100 pounds of gain, and the breaking strength of bones. Feeding ground bone seems to have greatly strengthened the bones of the pigs getting it.

Bone meal and hard wood ashes with corn meal, for hogs (pp. 15–17).—This is a detailed account of an experiment briefly reported in Bulletin No. 25 of the station (See Experiment Station Record, Vol. II, p. 301).

Conclusions drawn from experiments on the effects of various food rations on the carcasses of hogs (pp. 18, 19).—For a similar summary of four years' experiments in pig feeding at the station see below, p. 438.

Whole oats vs. ground oats for hogs (pp. 20–24).—An experiment with four lots of three pigs each, in which rations consisting of one third whole oats to two thirds corn meal and the reverse proportion, were compared with rations consisting of one third ground oats to two thirds corn meal and the reverse, the pigs being changed from the whole to the ground oats and *vice versa* in alternate periods. The trial extended over four 30-day periods.

The detailed results are tabulated. In general, the results were best with ground oats and in the proportion of about 1 part of oats to 2 parts of corn meal.

Where the ration contained one third ground oats and two thirds corn meal, the average of four trials shows that only 403 pounds of feed were required for 100 pounds of gain. This is the best average ever attained by us in any feeding trial with hogs as old as these [108 to 125 days at the beginning of the experiment], and shows in a remarkable degree the value of the oats when mixed with corn.

Skim-milk for mature vs. growing hogs (p. 24).—Two grade Poland China hogs 255 days old, and two of the same breed 126 days old at the beginning of the trial were given "all the skim-milk they could

eat, with a little corn meal stirred into it," during 63 days. The tabulated results show that the food consumed per 100 pounds of gain was, in the case of the mature hogs, 1,430 pounds skim-milk and 301 pounds corn meal, and in that of the growing hogs, 1,024 pounds skim-milk and 174 pounds corn meal.

Experiments with pigs before and after weaning (pp. 24–31).—As experiments on this subject were continued in 1890, the two years' work is treated together, p. 438.

Length of intestines of hogs (pp. 31–33).—According to the tabulated results of measurements of thirty-nine hogs the total length of the large and small intestines ranged from 18 to nearly 25 times the length of the body.

Darwin puts it* as 13.5 to 1, so that now we may say that the intestines of the modern, improved hog are nearly two and one half times as long as those of the wild hog, and nearly one and one half times as long as those of the common animals from which the data used by Darwin were obtained. * * * It may not be that the modern hog can digest his food any more thoroughly than his ancestors, though I suspect he can, but it is altogether probable that he is enabled to eat larger quantities of food in a given time, and therefore gives better returns for what is fed him.

Relation between weight of hogs, gain made, and food required for 100 pounds of gain (pp. 33–35).—A table is given showing the relation between weight of hog and food eaten, gain made, and food required for 100 pounds of gain, condensed from "the results of over one hundred feeding trials with over three hundred hogs, ranging in weight from under 50 to over 300 pounds," with a discussion of the same.

Practical conclusions (pp. 36–41).—A popular discussion of the subject of pig feeding.

Summary of pig-feeding trials (appendix, pp. 233–243).—"All the more important data relative to the various feeding trials at this station" are summarized in tables, and general averages are deduced for pigs of different weights.

VARIATIONS IN THE YIELD AND QUALITY OF MILK, S. M. BABCOCK, PH. D. (pp. 42–62).—Observations during the month of April of the milk of four cows taken at random from the station herd showed an average daily variation of from 1.18 to 1.8 pounds of milk; and tests made of the amount of fat in the milk of five cows for one week in April showed "an average daily variation of about 8 per cent in the yield of fat."

Milking one teat at a time (pp. 44–47).—At the evening milkings in several cases the milk of each teat was kept by itself, to be weighed and tested for fat content. "At each milking the teats were milked in a different order than at the preceding milking, so that after four milkings each teat had been milked first, second, third and last." The results are presented in tables. At any single milking there was "a decided difference in the quality of milk from the different teats," that

* Darwin, Animals and Plants Under Domestication, I, p. 77.

from the second teat being the richest, and from the fourth the poorest. "If, however, we take the average for each teat for the first four milkings, independent of the order of milking, we find that so much of the difference has disappeared that it is doubtful about there being any difference in the physiological functions of the different quarters of the udder. * * * The average per cent of fat in the milk was much less than in milk from the same cow when milked in the ordinary way, two teats at a time." Thus a cow giving milk containing 5 per cent of fat gave, when milked one teat at a time, milk averaging for four milkings 3.92 per cent of fat; and in the case of another cow the milk, usually containing 4 per cent of fat, fell to 2.7 and 3 per cent when milked in this way.

Milking fast and slow (pp. 47–50).—In tests in which cows were milked in from three to four minutes and double that time, the yield of milk seemed to be very little if any affected, but in every case richer milk was produced when the cows were milked fast than when they were milked slowly. This difference in quality, however, seemed to decrease gradually, though not to disappear altogether.

Change of milker, methods of milking, milking tubes vs hand milking, and change of quarters (pp. 50–56).—Tests made on these subjects seemed to show that change of milker, manner of milking, and change of environment all exert a more or less decided influence, temporarily at least, on the quantity and quality of the milk produced, the fat being as a general rule more sensitive to such changes than the other ingredients or the total yield of milk.

Effects of dehorning upon the composition of milk (pp. 57–62).—Ten cows were dehorned in the evening just before milking.

There was a very marked difference in the behavior of the different cows, some of them being scarcely affected, while with others the effect was decided. With all the cows that fell off either in yield or quality, there was at the next morning's milking an improvement, this being more marked in the per cent of fat than in the yield of milk. In some cases this was sufficient to entirely obscure the immediate effect.

The milk yield of other cows in the stable "was diminished almost as much on the evening that the dehorning was done as was that of the dehorned cows."

FIBRIN IN MILK, S. M. BABCOCK, PH. D. (pp. 63–69).—A briefer account of investigations previously reported in Bulletin No. 18 of the station (See Experiment Station Record, Vol. I, p. 161).

DIGESTION EXPERIMENTS WITH CORN SILAGE AND FODDER CORN, F. W. WOLL, M. S. (pp. 69–122).—An account of two feeding experiments each with two cows, "conducted for the purpose of ascertaining the relative value of corn silage and fodder corn for milk and butter production, and also to determine the digestibility of Indian corn after it has passed through the field-curing process or through the ensiling process."

Tabulated data are given regarding the composition of the fodder corn, corn silage, wheat bran, and corn meal fed; temperature of stable; live weight of animals; water drunk; food consumed; production and quality of milk; amounts of milk, solids, fat, and casein produced per pound of digestible matter consumed; weight and composition of butter produced; churnability of milk fat; pounds of milk required to make 1 pound of butter; average time required for churning; composition of samples of butter fat; average composition of skim-milk and butter-milk; number and size of fat globules in whole milk and skim-milk; composition of dung and of food residues; and the co-efficients of digestibility of fodder corn and corn silage. The main results of the experiments are briefly stated by the author as follows:

(1) The digestibility of corn silage is somewhat higher than that of dry fodder corn of the same variety and maturity. The same holds good with the rations tried, where bran and corn meal were fed in connection with the silage of fodder corn.

(2) The digestible matter of corn silage and fodder corn have practically an equal value for milk production.

(3) The churnability of the milk fat was improved in the second experiment on exclusive silage food; in the first experiment no definite results were arrived at.

(4) The fat globules of cows' milk increase in number and decrease in size as the period of lactation advances. Dry food decreases the number and increases the size of the fat globules.

EXPERIMENTS WITH FODDER CORN AND SILAGE, F. G. SHORT (pp. 123–145).

Yield and composition of different varieties of silage corn (pp. 123–126).—Nine varieties of corn, comprising flint, dent, sweet, and silage corn, were sampled September 6 by cutting the crop on an area of 120 square feet and from these large samples taking subsamples for analysis. From the data obtained the weight of green corn, and the total dry matter, sugar, and protein in the same per acre were calculated for each variety. The largest amount of dry matter (14,070 pounds per acre) was furnished by the Southern Horse Tooth, and this variety also produced much the largest amounts of sugar and protein. It is evident from the table that marked differences in composition as well as yield exists between the Northern and Southern varieties, and that the weight of green fodder per acre is no indication of the true value of the corn.

Method of planting and time of cutting (pp. 126, 127).—It is recommended that large varieties be planted in rows 4 feet apart and the kernels dropped singly about 8 inches apart in the row, small varieties in rows 3½ feet apart with the kernels dropped once in 6 inches, and that the corn be cut when it has "just passed the glazing stage" with the flint varieties, and when "well dented" with the dent varieties.

Comparison of ensiling and shocking fodder corn, and silage vs. fodder corn for milk and butter production (pp. 127–141).—The experiments on the first subject were in continuation of previous ones. Four silos were filled with three varieties of corn, and a part of the same crop of each

variety was cut and shocked in the field at the same time the silos were filled, a part being brought to the barn and stored after a month's standing, and the remainder left in the field until wanted for feeding. The tables showing the losses in dry matter and crude protein in ensiling and shocking, indicate that "with a tight silo and fodder at the right stage of maturity, corn can be preserved in the silo with a loss of 16 per cent of nutritive matter;" and that in this experiment, during which very little rain or snow fell, "the fodder corn lost 16.54 per cent of dry matter."

Three experiments were made to compare the feeding value of the silage and fodder corn, in each of which four cows were used, two being fed on each of these feeding stuffs, supplemented by hay, bran, and oats, and changed to the opposite feed in a second period. Data regarding the amounts of dry matter and protein eaten and the milk and butter fat yielded during each period of the separate trials, together with a summary of the results of the three trials, are tabulated.

In conclusion the author makes the following statements:

(1) Notwithstanding the fact that the fall of 1888 was exceptionally dry, and well suited to the curing of fodder corn, the fodder shocked in the field lost a little more dry matter than that preserved in the silo. Consequently, as far as the loss of dry matter is concerned, there is little difference in the results between the method of storing fodder in small silos, as managed in this case, and that of curing in shocks during an exceptionally dry fall.

(2) There is but little difference in the feeding value of the silage and fodder corn when preserved under the conditions indicated above. In both cases the small differences are in favor of the silage.

Losses in corn stalks due to weathering (pp. 141,142).—Determinations of the total amounts of dry matter and protein in a row of corn fodder (stover) harvested when the corn was ripe, and in one as nearly like it as possible, after standing in the field for two months, implied a loss, in duplicate samples, of 12.76 and 22.83 per cent of the total dry matter, and of 59.6 and 71.55 per cent of the total protein by weathering.

Weight and composition of the different parts of the corn plant (pp. 143–145).—Three tables show the weight of different parts of the plant, and the distribution of dry matter and protein in these different parts, for five varieties of corn. "Taking the average of the five samples given in the table, we see that nearly 50 per cent of the dry matter, and over 30 per cent of the protein in fodder corn is present in the much-neglected stalk."

Clover silage (p. 145).—A trial of preserving clover in a silo, showed "a loss of 15.41 per cent of dry matter and 12.66 per cent of protein" during ensiling.

COMPARATIVE VALUE OF WARM AND COLD WATER FOR MILCH COWS, F. H. KING (pp. 146–188).—As this experiment was continued in 1890, the two years' experiments are described together below, p. 445.

SOIL INVESTIGATIONS, F. H. KING (pp. 189-206).—The importance of investigations in the physics of the soil has led to the appointment of an agricultural physicist at this station.

The work in soil physics which has been commenced, relates, among other questions, specifically to the following:

(1) To what depth below the surface is the water contained in the soil drawn upon by plants?

(2) What is the amount of water the available depth of soil is capable of storing?

(3) How much of the waters stored in our soils different kinds of cultivated plants can use and yield average crops?

(4) What is the amount of water a given soil must contain at the beginning of the growing season, supplemented by our average summer rain fall, to give an average yield?

(5) When the amount of stored water in the spring is above or below that best suited to plant growth, what distribution of crops and what sort of tillage will yield the largest returns?

(6) What volume of air various soils should contain to give the largest yields with different varieties of cultivated plants?

(7) Do our present methods of tillage impart the desired porosity to soils?

(8) Influence of different methods of tillage on soil temperatures.

(9) Influence of our various methods of tillage on the rate of evaporation.

(10) Whether one variety of corn, for example, requires more water than another to produce a pound of dry matter.

The aim in approaching these questions has been to make each case definitely a field study with soils undisturbed, except by the operations of tillage, using laboratory methods only as checks on field work and as suggestive of lines of procedure.

Soil water.—On the basis of investigations by Hellriegel in Prussia, it is estimated that the amount of water required by a crop of corn is nearly 12 inches of rain-fall, which is more than one third of the year's rain-fall at the station, and within 3 inches of the rain-fall during the months of May, June, July, and August, that being 15 inches. The need of more definite knowledge regarding soil water is urged as follows:

Since soils may contain either too much or too little moisture, for the best results in plant growth it is evident that before methods of tillage, intended either to diminish or conserve the amount of water contained in the soil at any time, can be intelligently applied, many very fundamental facts and principles need to be better understood.

Just as in stock feeding it is important to know how many pounds of this or that combination of food stuffs are required to produce a pound of mutton, pork, or beef, so in plant feeding it is equally important to know how many pounds of water on this or that kind of soil are required to produce a pound of clover, corn, oats, or potatoes.

More knowledge is needed as to the storage capacity for water of our soils in their natural conditions and positions; as to the per cent of this water available for different crops in the production of good yields; as to the depth below the surface different plants can utilize soil water; and as to the best methods of reducing the amount of soil water when the soil contains too much, and of conserving it when the stock is below the average needed.

If we knew very definitely the amount of water our different varieties of soil should contain at the beginning of the growing season, when supplemented by the mean summer rain-fall, to bring good crop yields, it would be a simple matter for any farmer to determine whether the water present in his soils was above or below the amount

needed, and thus obtain a much better basis for judgment as to how to distribute his crops on his land, as to what his yields were likely to be and whether methods of tillage intended to reduce or conserve the moisture already in the soil should be adopted.

Position and attitude of the water-table.—To study the foregoing and allied questions from the experimental side it seemed important to know at the outset the distance from the surface of the cultivated fields and experimental plats to permanent water in the ground at the university farm, and whether or not this water was drawn upon, especially during dry seasons, by the crops growing upon the land. The investigation was begun in August, 1888, and has been continued since when time permitted.

With the aid of an 8-inch post auger, provided with an extension handle, four lines of wells have been bored, three of them constituting north and south parallel series, and the other crossing these at a right angle. * * * After taking the levels of the several wells and of the water in them, it was found that the water stands everywhere in the ground above the level of the water in the lake, and that the level of the water-table rises where the ground rises and falls where it falls, but not in such a manner as to make the two surfaces parallel. For example, at a distance of 130 feet back from the lake shore the water in the ground stands about 2 feet above the lake level, but farther back the difference of level is nearly 10 feet. * * * A study in other places shows that similar conditions exist elsewhere. * * * That this attitude of the water-table is not due to simple capillary action in the case, is proven by the fact that water was not reached in the two central wells until a stratum of green sand, 2 feet below the level of the lake, had been entered; this being reached the water rose slowly until it stood 6 inches above the lake level.

Fluctuations in the level of the water-table.—To ascertain if possible whether vegetation is able to avail itself, through capillary action, of the permanent ground water and thus tide over seasons of drought, the variations in the level of the water in the ground have been measured by means of an instrument constructed for the purpose, which is sufficiently sensitive to allow changes of level less than one hundredth of an inch to be detected. More than six thousand measurements of the level of the water in the wells of the four series have been made during the year, and as the water in these wells lies at different distances below the surface, some of the wells being below corn, others below oats, meadow, pasture, or woods, while others still stand in ground which bore no crop, the surface being simply tilled to prevent the growth of weeds, it was hoped that in case the permanent water in the ground was drawn upon by vegetation to any notable extent the fact would be revealed by differences in the fluctuations of the water level in the several wells.

The fluctuations observed have been surprisingly marked, and so varied as to indicate that several causes must be operating conjointly to produce them, but at this stage of the investigation it is evident that a longer series of observations and a more critical analysis of them than is now possible is required for a solution of the problems involved. Among the facts which the present study have developed are these:

(1) There are, from May to October, daily fluctuations of the water level in the ground, the water either rising during the night or falling less than it did during the day.

(2) There are fluctuations extending over several days, during one portion of which the water falls at a rate faster than the average, while during the remainder of the time it either makes a positive rise or else falls at a rate below the average.

(3) The diurnal fluctuations are very unequal in magnitude, varying in different wells from less than 0.01 or 0.02 of an inch to 1.7 inches.

(4) The longer-interval fluctuations are not exactly synchronous, there being a lagging, with some wells, of more than 24 hours.

(5) Corn is able to draw upon the permanent water in the ground, when it lies at a depth at least as great as 7½ feet, in the case of a subsoil of rather coarse sand.

(6) Corn may reduce the per cent of water in a subsoil of sand to 7 per cent of the dry soil at a depth of 40 inches below the surface, and when the water table is but 42 inches, still lower.

The capacity of soil to store water.—The fact universally observed that during seasons of drought vegetation suffers from lack of moisture, even when the water table lies within 5 feet of the surface, proves conclusively that the rate at which capillary action can carry water toward the surface is not great enough at all times to meet the demands of cultivated crops, and this being true it is important to know, first, the capacity of the upper 5 to 7 feet of soil to store water; and, second, the per cent of this stored water different varieties of cultivated plants can profitably use; for these facts stand in the same relation to plant feeding that a knowledge of the amount of hay and grain stored in the barn does to stock feeding.

To ascertain how great the storage capacity of undisturbed soil may be, five tin cylinders, each 1 foot in length and 6 inches in diameter, were filled with soil in its natural condition by forcing them into the ground one above the other.

From this investigation, details of which are given, it appears that the upper 5 feet of soil were able to store 21.24 inches of water, or three fifths of the total annual rain-fall in this locality. Experiments with reference to the rate of drying and to the amount of water which these soils would hold when saturated are reported. From the latter it appears that the soil under experiment, when thoroughly filled with water, as might be the case after heavy rains, might contain 24.48 inches of water to each square foot of surface, or more than two thirds the average annual rain-fall.

Rate and extent of capillary movement of water in soil in its natural condition.—It appears to be generally conceded that capillary action is an important factor in lifting the ground water toward or to the surface, where plants can avail themselves of it and of the minerals it may hold in solution. How rapid this movement may be in soils of different kinds and depths, as they exist undisturbed except by the processes of tillage, is a question having many important practical bearings; and yet our specific and positive knowledge on this subject is very limited indeed. The fact that vegetation, during seasons of drought, suffers for lack of moisture, even where permanent water exists in the ground within a few feet of the surface, is conclusive evidence that the normal rate of capillary movement is not very great. * * *

[This is illustrated] by the following observations: On May 13, while corn ground recently planted contained 23.33 pounds of water to the 100 pounds of dry soil, in the surface 6 inches, clover growing not 2 rods distant in the same kind of soil, had drank the water so much faster than capillary action could bring it that there remained but 8.59 pounds to the 100 pounds of dry soil. * * *

These facts illustrate in a very forcible manner the great power vegetation has of withdrawing water from the soil, and how naked tillage conserves it, while at the same time they furnish the strongest possible argument against allowing even a single weed to grow in a field where other crops are expected.

To study the rate at which water may rise in different kinds of soil in their natural conditions, the cylinders above described were placed with their feet resting in water 1 inch deep after the soil had been dried, and the rate at which the water rose in them noted by daily weighings. * * * The rate at which the several samples of soil became saturated with water is shown in a table. [It appears that the soil in the cylinder was not saturated with water at the end of 36 days.] The per cent of water in soil on which corn had been grown was determined down to a depth of 3 feet on October 23, and again on December 13, standing water in the ground at the time being 7.5 feet below the surface. * * *

[The data given indicate that] the third foot of soil, which was only 4½ feet from permanent water, only gained from below in 51 days about 0.025 pound of water. Here again the facts indicate in an emphatic manner that during ordinary seasons we need to do what we can to save not only the moisture already in the soil, but also that which falls as rain from time to time during the summer; they point, too, with equal emphasis, to the necessity of draining cultivated soils where the water in them naturally lies too near the surface, rather than depend upon capillary action and evaporation to do the work.

Experiments with reference to the rate of capillary movement in fine sand and to the influence of stirring the soil on the rate of evaporation are reported. From the latter the following suggestions were drawn, though the author is careful to state the need of further investigations for their confirmation:

(1) A tool like the disk harrow, or like the curved-toothed harrows, which cut narrow and comparatively deep grooves in the soil, leaving undisturbed ridges between them, tend to dry the ground rapidly and deeply.

(2) Tools like the plow and some forms of cultivators, which cut the whole surface of the ground, leaving a loose layer of soil on the top, tend to dry the loosened soil while the loss of moisture from below by capillary action and evaporation is diminished.

(3) Deep plowing in the spring, especially if the soil is heavy, and if coarse material is turned under, would tend, unless prevented by early, heavy rains, to produce a deficiency of moisture for shallow-rooted plants, and for deep-rooted plants during the early part of the season, by partially cutting off the water supply at a depth below the roots.

(4) Shallow plowing or surface stirring would tend to diminish surface evaporation, and at the same time allow capillary action to lift water from below to the roots of young and shallow-rooted plants.

(5) Fall plowing and early spring treatment with tools like the disk harrow would tend to draw the water to the surface with the minerals held in solution, and thus concentrate the fertility at the surface for later use, thus preventing so much being lost by underdrainage.

PRICKLY COMFREY VERSUS RED CLOVER, F. W. WOLL, M. S. (pp. 207–211).—Four cuttings of second year's growth of prickly comfrey yielded at the rate of nearly 34 tons, and three cuttings of red clover at the rate of over 26 tons of green fodder per acre. From the tabulated analyses of the several cuttings of these materials and calculations of the food nutrients furnished in the same per acre, it would seem that "the prickly comfrey, while yielding an enormous quantity of green fodder per acre when once established, can not, all things being considered, compare in value as a cattle food with red clover, looking at both forage plants from the standpoint of the general farmer."

LOSS IN HAY DUE TO WEATHERING, F. G. SHORT (p. 212).—Determinations of the dry matter and protein showed that "by leaving the hay out only four days after cutting, during which time there was a rain, there was a resultant loss of over 4½ per cent of dry matter, and over 3½ per cent of protein. [Six weeks later] nearly one fourth of the dry matter and an equal proportion of protein had disappeared."

STABLE FLOOR AND WATERING TROUGH FOR THE DAIRY STABLE, L. H. ADAMS (pp. 213, 214).—An illustrated description of a stable floor and a watering and feeding trough.

COMPOSITION OF FEEDING STUFFS, F. W. WOLL, M. S. (pp. 215–223).—A popular discussion of the constituents of feeding stuffs, and of Wolff's feeding standards, together with a table taken from the annual report of the Connecticut State Station for 1888, showing the average composition of American feeding stuffs.

Wisconsin Station, Seventh Annual Report, 1890 (pp. 280).

REPORT OF DIRECTOR, W. A. HENRY, B. AGR. (pp. 1–3).—Brief general statements regarding the work of the station.

IN MEMORIAM (pp. 4–6).—A brief account, by H. C. Adams, of the life and work of Hon. Hiram Smith, of Sheboygan Falls, Wisconsin, who, as regent of the University of Wisconsin for 12 years, did much to promote the interests of the agricultural department of the university and the experiment station. "The Wisconsin farmers' institutes came as the outgrowth of his thought; to them he gave a gratuitous and splendid service."

EXPERIMENTS WITH SHEEP, W. A. HENRY, B. AGR. (pp. 7–20).

Lambs fed on milk and grain (pp. 12–14).—This experiment was made to observe the amount of food required to produce 100 pounds of live increase with lambs, and to compare the cost of gain in lambs and in pigs.

Four lambs were taken from their mothers when about 10 days old, and fed whole milk from a bottle four times daily for 21 days. During this time they consumed 226 pounds of whole milk, gaining 39 pounds, or nearly half a pound each daily. At this rate it would require 579 pounds of whole milk for 100 pounds of gain. Whole milk has sold as low as 30 cents per hundred pounds this summer at Western creameries, but valuing it at 60 cents, a fair summer price, the cost of 100 pounds of gain would be $3.47.

The lambs were next put on sweet skim-milk, and fed oats with green clover and green fodder corn. For the first period of 28 days they drank 424 pounds of sweet skim-milk and ate 14 pounds of oats and 32 pounds of green clover, gaining 53 pounds, or nearly half a pound each daily. At this rate 800 pounds of sweet skim-milk, with 26 pounds of oats and 60 pounds of green food, would make 100 pounds of gain. Valuing skim-milk at 25 cents per hundred pounds, oats at 80 cents per hundred pounds, or about 26 cents per bushel, and green corn and clover at $2 per ton, the food would cost $2.30 for 100 pounds of gain. In subsequent periods the cost increased gradually as more grain was consumed. In September the cost ran up to $4.50 per hundred pounds gain. During the last period in September and October, after the milk was withdrawn, the cost was $4.06 per 100 pounds gain. During this period some hay was fed, which was charged at the rate of $6 per ton.

Food required for 100 *pounds of gain with lambs and with pigs.*

	Sweet milk.	Sweet skim-milk.	Oats.	Corn meal.	Corn meal and shorts.	Green fodder corn and green clover.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
With lambs	....	800	26	....	....	60
With lambs	....	913	64	....	....	131
With pigs before weaning	654	....	....	....	198	....
With pigs after weaning	964	....	....	92	....	....

"It will be seen that the lambs show up exceedingly well in this comparison."

Soiling ewes and lambs (pp. 14–16).—Ten ewes and ten lambs, the latter about a month old at the beginning of the trial, were fed during 57 days on green clover, green corn, and oats; at the end of that time two ewes and two lambs were dropped and the experiment continued with the remainder. Tables give the weight of animals, total food consumed, food consumed per 100 pounds of gain, and cost of the same during the experiment.

During the first 55 days the ten ewes gained 55 pounds and the lambs 192 pounds, and 100 pounds of gain cost, at the prices for feeding stuffs given above, $3.66; during the next 51 days the (eight) ewes gained 52 pounds and the (eight) lambs 138 pounds, and 100 pounds of gain cost $3.22; and during the last period (28 days), while the lambs were being weaned and placed on dry food, the cost was $5.10 per 100 pounds of gain.

Fattening wether lambs (pp. 16–19).—Three lots, each containing three wethers about 8 months old, were fed during 86 days as follows: lot 1, shelled corn, corn silage, and fodder corn; lot 2, equal parts, by weight, of corn and oats, with clover silage and clover hay; lot 3, oil meal, oats, clover silage, and clover hay—that is, rations low, medium, and high in nitrogenous compounds. The weights of the wethers, the food consumed, cost of the same, and gain by periods for each lot are tabulated, and an appendix contains data obtained at time of slaughtering regarding the weight and size of parts. During the experiment lot 1 gained 98 pounds, at a cost of $3.28; lot 2 gained 96 pounds, at a cost of $3.86, and lot 3 gained 92 pounds, at a cost of $4.96. Thus the ration consisting of shelled corn, corn silage, and fodder corn produced the largest gain and cost the least. The animals were slaughtered, and "no difference in the proportion of fat to lean meat was observed."

Cost of producing mutton and beef compared (pp. 19, 20).—From a comparison of the results of forty-four experiments in fattening steers, three of which were made at the station, with the above results with wethers, the author concludes that "our wether lambs made a more economical gain than did the steers in either case."

EXPERIMENTS WITH HOGS, W. A. HENRY, B. AGR. (pp. 21–64).

Feeding for fat and for lean (pp. 21–31).—Two lots of three pigs each, all 134 days old at the beginning of the trial, were fed from November 4 to March 10, as follows: lot 1, for the first 13 weeks, all they would eat of a mixture of 2 parts of shorts and 1 part of bran, and after that corn meal; and lot 2, corn meal during the whole trial. After the first six weeks both lots were given hard-wood ashes in addition. The gains in weight, food consumed, the weights of blood and liver, and analyses of the sixth-rib cut after slaughtering are tabulated for each lot, the data obtained at time of slaughtering being detailed more fully in an appendix. Lot 1 gained 198 pounds while on shorts and bran, or 100 pounds for 524 pounds of food consumed, and 187 pounds while on corn meal, or 100 pounds for 448 pounds of food consumed. Lot 2 gained

during the whole period (19 weeks) 177 pounds, or 100 pounds for 726 pounds of corn meal consumed. "At slaughtering time the carcasses of the hogs fed on shorts bran showed the most lean meat, the excess being about 17 per cent, as shown by chemical analyses for that portion of the body surrounding the heart."

Our investigations showed the following points in favor of the shorts-bran-corn-fed hogs over those getting corn only: (1) a far more rapid growth; (2) a much more economical gain for food consumed; (3) much more blood in the body; (4) larger livers; (5) a larger proportion of lean meat or muscle to fat; (6) a larger proportion of ash to a given volume of bone; (7) somewhat stronger bones in proportion to weight of body.

Effects of food upon the carcass (pp. 31, 32).

Having now completed four years of feeding trials, where especial reference was had to the effects of food upon the carcass, we feel warranted in maintaining that the kind of food supplied to young growing pigs has a very marked effect upon the animal carcass; that foods rich in protein tend to build up strong muscular frames and large individuals, with ample blood and fully developed internal organs; that exclusive corn feeding with pigs, even after they have obtained a good start on proper food, tends to dwarf the animal in size and prematurely fatten it; that, owing to the larger amount of ash contained, and perhaps for other causes, pigs receiving the usual nitrogenous foods have stronger bones than those of pigs fed on corn, and that the bones of pigs fed on corn contain the least mineral matter. We have further found that where growing pigs are fed exclusively on corn, the strength of the bones and the quantity of mineral matter they contain can be greatly increased by feeding mineral matter in the shape of hard-wood ashes or ground bone. * * *

It appears plain to us that the excessive feeding of corn, with its deficiency in ash, tends to repress the natural development of the muscles, reduces the blood and some of the internal organs of the body, and gives weak bones. Supplying nitrogenous foods to growing pigs so nourishes the body that the muscles and internal organs are developed to normal size, and the blood is abundant. With these foods there is usually an abundant accompaniment of ash, which nourishes the bones, giving them their normal strength.

Effects of feeding bone meal and hard-wood ashes to hogs living exclusively on corn (pp. 33–42).—For an account of these experiments see Bulletin No. 25 of the station, or Experiment Station Record, Vol. II, p. 301. In addition to the data given in the bulletin an appendix to the report contains the weights of parts, weight of intestinal fat, and length of intestines and of body as observed at time of slaughtering.

Cost of feeding pigs before and after weaning (pp. 42–52).—This experiment is in continuation of one made in 1889, the object of which was to observe the cost of the food consumed by pigs before and after weaning. Each year the pigs from four sows were weighed as soon as born and account was kept of all food consumed by the sows and the pigs.

In 1889 the food given was skim-milk and a mixture of equal parts of corn meal and wheat middlings. Three litters were fed all they would eat of this ration, in addition to the mothers' milk; the fourth was fed entirely on the dam's milk until weaned.

In 1890 the food was as follows: lot 1, corn meal and milk before wean-

ing, and corn meal alone after weaning; lot 2, corn meal and milk before and after weaning; lot 3, corn meal and shorts before and after weaning; lot 4, corn meal and ground oats before, and corn meal and barley after weaning.

The pigs were all weaned when 70 days old; after this the feeding was continued in 1889 for from a month to a month and a half, and in 1890 for 7 weeks. The details of the trials, including the amounts of feed consumed, the weight of the animals, the feed required per 100 pounds of gain and cost of the same, for each lot before and after weaning, are tabulated.

In 1889 the average cost of food consumed per 100 pounds of gain in live weight was, for sow and pigs before weaning, $3.14, and for the pigs after weaning, $2.85, allowing 25 cents per 100 pounds for the skim-milk and $14 per ton for the grain mixture. Three of the sows gained respectively 29, 33, and 4 pounds, and one lost 6 pounds while suckling the pigs.

The teaching of these trials is that it pays to feed sows when suckling pigs so heavily that even the dams will gain in weight, for the cost of the gain made by the pigs and their dam is then cheaper than the gain of the same pigs when grown. [In 1889] the combination of corn meal and skim-milk gave excellent results, and corn meal with shorts did equally well. Where the sow was fed ground oats poor returns followed, this feed not being very satisfactory when cost [$18 per ton] is considered. There was little difference in the amount of food required for a pound of growth with the pigs of lots 2 and 3 before and after weaning, and we may conclude that there is no cheaper way of feeding pigs than through the dam. * * *

This year [1890] we produced gain somewhat cheaper while the pigs were with the sow than after they were weaned, while last year [1889] the reverse was the case. Averaging the trials for the 2 years [at the prices of feeding stuffs given above] we have $2.87 as the cost of producing 100 pounds of gain with pigs before they are weaned, and $2.75 per 100 pounds gain as the cost of food for pigs immediately after weaning, a difference of $0.12 per 100 pounds gain.

Ground barley for fattening hogs (pp. 53–59).—(1) *Ground barley vs. corn meal.*—To compare the value of barley and corn, ten pigs, 391 to 407 days old at the beginning of the experiment, were divided into two lots of five each, one lot being fed barley meal and the other corn meal during 8 weeks.

(2) *Barley meal and skim-milk vs. corn meal and skim-milk.*—During 9 weeks six pigs, 130 to 140 days old, were fed barley meal and skim-milk, and six others, of the same age, were fed corn meal and skim-milk. The amounts of food consumed, and the weight of the individual pigs are tabulated for each trial.

In these experiments barley meal was found a very satisfactory feed for hogs, though they did not make quite as good a gain in either case as did those fed on corn meal. In both trials it required about 8 per cent more barley meal, by weight, than corn meal to make 100 pounds of gain. * * * The barley-fed hogs drank a great deal more water than those getting corn.

Cooked potatoes for fattening hogs (pp. 59–64).—Six lots of pigs, about 10 months old, were fed during 42 days as follows: lots 1 and 5, corn

meal wet with water; lots 2 and 6, 3 pounds of potatoes to 1 of corn meal; lot 3, 3 pounds of potatoes to 1 of shorts, and lot 4, 2 pounds of potatoes to 1 of corn meal. The first four lots contained three pigs each; lots 5 and 6, two each. Tables show the food consumed, weights of animals, and food consumed per 100 pounds of gain for each lot.

It was found that the hogs ate the cooked potatoes best when there was the least water in the mashed potatoes. * * * Seven hundred and eighty-nine pounds of potatoes took the place of 178 pounds of corn meal. To effect a saving of 100 pounds of corn meal, 443 pounds of potatoes would be required. From this we see that it required nearly 4½ pounds of potatoes to take the place of 1 pound of corn meal. This makes a bushel of corn worth about 4½ bushels of potatoes. * * * It appears that the dry matter of corn was superior to an equal amount in potatoes for making gain with these hogs. The trial with shorts and potatoes shows that shorts did not give quite as good results with the potatoes as did corn meal.

GROUND OATS VERSUS BRAN FOR MILK AND BUTTER PRODUCTION, F. W. WOLL, M. S. (pp. 65–89).—Two separate experiments, one of 8 weeks and the other of 6 weeks' duration, were made to compare the value of ground oats and bran when fed to milch cows. "Two cows were used in the first experiment and four in the second. The cows were fed the same quantities, by weight, of oats and bran, 8 pounds daily per head in the first experiment and 10 pounds in the second, and in addition, the same fundamental ration of corn meal, hay, and corn silage or fodder corn. The effect of similar weights of oats or bran in a ration for milch cows was thus studied."

The live weight of animals, water drank, yield of milk and fat, average yield of the same and of butter, and amounts of milk, fat, and butter produced per pound of dry matter consumed on each ration, are given for each feeding trial, together with the viscosity of the milk and the number of fat globules for the first experiment, and a general summary for the two experiments taken together are stated in tables. The determinations of the fat globules in the milk, which were made in the first experiment, showed that the number of fat globules increased on the oat feed, and their relative size decreased correspondingly.

From the two experiments the author draws the following conclusions:

"(1) With a ration of 10 pounds, per day and per head, of ground oats or of bran, fed in connection with the same ration otherwise, there was a 10 per cent greater yield of milk and milk fat on oats than on bran.

"(2) At the present prices of the two feeding stuffs [bran $11 and oats $17.40 per ton] bran is the more economical food for milch cows."

CORN SILAGE VERSUS DRY FODDER CORN FOR MILK AND BUTTER PRODUCTION, F. W. WOLL, M. S. (pp. 80–97).—In continuation of experiments on this subject, duplicate experiments were made 1889–90, each with four cows and of 6 weeks' duration, the time being divided into two equal periods. In each experiment, in addition to the ration

of hay, bran, and oats, two cows received as much silage and the other two as much dry fodder corn, from the same variety of corn and cut at the same time as that used for the silage, as they would eat during three weeks. At the end of that time the two cows on silage were changed to fodder, and *vice versa.* Data regarding the live weight of animals, water drank, food consumed, milk and milk fat produced, and amounts of the same produced per pound of dry matter in the fodder corn and the silage, and percentage of fat recovered in the butter, are tabulated for each experiment, together with the following summary of the two experiments.

Average of two experiments, corn silage vs. fodder corn.

One pound of dry matter in—	Milk.	Milk fat	Fat churned out.
	Pounds	*Pounds.*	*Pounds.*
Silage ration produced (average of two experiments, 8 cows)	0.769	0.032	0.031
Fodder-corn ration produced (average of two experiments, 8 cows)	0.860	0.036	0.035
In favor of fodder corn	0.091	0.004	0.004
Or in per cent	12	13	13

The cows ate less on the fodder corn, but were able to produce more milk and milk fat from each unit of food materials.

The three experiments of last year were all in favor of the silage, on an average 0.06 pounds more of milk (5.8 per cent) and 0.003 pounds more of fat (6.1 per cent) being produced for every pound of dry matter in the silage than in the fodder corn. In six experiments "corn silage with us has proved sometimes superior to dry fodder corn in nutritive value, sometimes inferior. Considering all trials conducted at this station, the conclusion will be that properly cured fodder corn and corn silage of similar variety and maturity are of equal value for milk and butter production."

A NEW METHOD FOR THE ESTIMATION OF FAT IN MILK, ESPECIALLY ADAPTED TO CREAMERIES AND CHEESE FACTORIES, S. M. BABCOCK, PH. D. (pp. 98–113).—For a description of this method see Bulletin No. 24 of the Station, or Experiment Station Record, Vol. II, p. 256.

INVESTIGATIONS RELATING TO THE COMPOSITION OF MILK, S. M. BABCOCK, PH. D. (pp. 114–119).

Composition of Wisconsin herd milk (pp. 114, 115).—The averages of a large number of determinations of fat in the milk of Wisconsin herds are tabulated, and the results of all the determinations made are stated in an appendix (p. 253). The average fat content calculated from these determinations is given as 3.68 per cent.

Variations in the composition of milk from different breeds (pp. 115–119).—Analyses are given of the milk of two Holstein cows throughout the period of lactation, together with analyses of the milk of other Holstein, and of Jersey, Guernsey, and Red Polled cows.

SOME EFFECTS PRODUCED BY ROLLING GROUND, F. H. KING (pp. 120–133).—This is a report of observations made in 1889 at the station by the author and in different parts of the State by six of the students in agriculture at the University of Wisconsin. The subjects treated were: the effects of rolling on soil temperature; rate of evaporation; germination of seeds of oats, clover, peas, barley, and grass; and yield per acre of oats.

The following summary is taken from the report:

(1) Rolling land makes the temperature of the soil at 1.5 inches below the surface from 1° to 9° Fah. warmer than similar unrolled ground in the same locality, and at 3 inches from 1° to 6° warmer.

(2) Rolling land by firming the soil increases its power of drawing water to the surface from below, and this influence has been observed to extend to a depth of 3 to 4 feet.

(3) The evaporation of moisture is more rapid from rolled than from unrolled ground, unless the surface soil is very wet, and then the reverse is true, and the drying effect of rolling has been found to extend to a depth of 4 feet.

(4) In cases of broadcast seeding, germination is more rapid and more complete on rolled than on unrolled ground, and the following differences in the completeness of germination have been observed: for oats, 4.2, 41.0, and 11.35 per cent; for peas, 35.7 per cent; for barley, 10.3, and for clover 1.2 per cent and 68.7 per cent greater on the rolled than on unrolled ground. These differences are greatest when dry weather, and least when copious rain follows seeding.

(5) In the experiment on oats, reported in full, the yields per acre stood, 61.12 bushels on the rolled ground and 58.89 bushels on the unrolled ground.

(6) The size of the kernels was larger on the rolled than on the unrolled ground.

(7) The oats from the rolled ground weighed 28.35 pounds per bushel and those from the unrolled 26.32 pounds per bushel.

(8) The oats from the rolled contained at the time of cutting 11.60 per cent of water and those from the unrolled ground 11.31 per cent.

(9) The observed effects of rolling on the yield and quality of the oats stand as isolated cases, and the observations must be repeated before general conclusions can be safely drawn.

SOIL WATER, F. H, KING (pp. 134–162).

Translocation of capillary soil water (pp. 134–139).—In his study of soil moisture the author has found, "on several occasions, that the distribution of water in the soil changes at times quite rapidly, so that one stratum has gained in water content at the expense of a contiguous one, and this redistribution of water may be conveniently designated 'translocation.'

"The translocation of soil water is occasioned in at least two ways, namely, (1) by changing the porosity of a given stratum of soil; (2) by changing the amount of water a given stratum of soil contains." Firming the surface soil by rolling draws water up from beneath. Rains also frequently give rise to a translocation of water. This is illustrated by accounts of observations made by the author on samples of soil taken at different depths before and after a rain or artificial sprinkling, from which it appeared that there was a marked decrease in the amount of water in the subsoil when the surface soil was wet. These observations

were confined to a clay soil underlaid with sand. Some of the bearings of these phenomena on the tillage of this class of soils are briefly discussed.

(1) *Cultivation after rains.*—Unless the ground is already too wet the stirring of the surface soil, wherever practicable, should follow just as soon after a considerable rain-fall as the tools will work well. The cultivation should, as a rule, be shallow, leaving a thin stratum of the surface soil finely pulverized and completely cut off from the ground below. If this is not done, the extremely rapid evaporation which takes place from undisturbed wet soil on hot, clear days may, even in a few hours, not only dissipate that which has just fallen but also a part of that which the rain has caused to be drawn toward the surface from lower levels, and thus leave the ground actually drier, as a whole, than before the rain, even though it may look more moist at the surface.

(2) *Watering transplanted trees.*—When dry weather follows the planting of trees it will be evident that simply wetting the surface may, in certain localities, do more harm than good, because, in these cases the roots, lying as they do at considerable depths, can not use water which remains at the surface, and as surface wetting may diminish the water content of the deeper soil, the soil about the roots is liable to be rendered drier than before the wetting. * * *

If, however, the surface soil about the trees is deeply spaded before watering, the water will then enter the ground more deeply by the direct force of gravitation, largely unimpeded by capillary action, while at the same time the ability of the soil to return the water to the surface will be reduced to the minimum, and if a good mulch is now added the water will be under the best conditions for being used by the tree. So, too, if the soil about the roots of transplanted trees is well firmed to insure the rapid transit of water to them, while the surface is left loose and well mulched at the time of setting to prevent capillary action upward above the roots and to permit the rains to penetrate downward to them, we start the tree under the best possible conditions for growth, so far as moisture is concerned.

(3) *Relation to irrigation.*—The bearing of these facts upon problems of irrigation will be evident to those directly interested, and need not be dwelt upon here.

Capillary movement of water in field soil in its natural condition and position (pp. 139–145).—(1) *Cases of slow movement upward.*—In the Annual Report of the station for 1889, p. 202 (See p. 434 above), are recorded observations indicating a very slow capillary movement of water in the soil of cultivated fields. Observations in the same line in 1890 are reported in this article. From samples of soil taken from the same field as in the previous experiments, it was determined "that the total gains of water in the upper 4 feet of soil in the field during 85 days [December 13, 1889, to March 8, 1890] were only 1.04 per cent of the weight of the dry soil, or an aggregate of 3.07 pounds. Rain-fall during the interval was 5.18 inches, or 26.98 pounds per square foot." In the same way it was shown "that the capillary movement upward into the upper 4 feet of soil under consideration during the 41 days from March 8 to April 18, 1890, when coupled with a rain-fall of 21.77 pounds of water per square foot, was only sufficient to increase the water of these 4 feet 11.38 pounds, barely one half of the rain-fall itself." Combining the observations during about 6 months from October, 1889, to April, 1890, it appeared that the lowest of the 4 feet of soil under consideration had increased its water content only 3.32 per cent, or 3.1 pounds per cubic foot, though at no time during this period was it more than $3\frac{1}{2}$

feet above the permanent water-table. That this small increase in the water of this soil was not due to a small water capacity is indicated by figures in a table showing the water content at two dates when it was very much larger than at any of the times when the other observations were made.

A second example of slow capillary flow of water into comparatively dry field soil is given as follows: On October 28, 1889, samples of soil were taken down to a depth of 5 feet from the summit of a rise of ground, and the amount of water content determined. Over this spot was then set a zinc-lined tray, 6 by 6 feet, and 8 inches deep, standing on legs 3 feet above the ground. Boards 8 feet long were then placed, one end on the tray and the other on the ground, all the way around, and these were covered with corn stalks, to shed water and prevent snow from drifting under the tray. In this condition this section of ground remained until April 14, 1890, when the covering was removed and samples of soil again taken, both under the tray and just outside the covered area. [The results are stated in a table which shows the per cent of water in the soil at the different depths.]

When it is stated that the piece of ground under experiment was seeded out to timothy and clover, three important facts are brought out.

(1) The upper 4.5 feet, shielded from rain, sun, and winds, was drier after the lapse of 168 days, comprising the winter season, than at the time of covering, showing that the rate of capillary flow was insufficient to keep pace with the loss of water by evaporation, and possibly by lateral or downward translocation.

(2) Even outside the shelter, with a precipitation of 58.54 pounds to the square foot, the third foot was drier by an average of 0.79 per cent of its dry weight or about 0.7 pounds, while the lower 18 inches showed only the small gain of 1.02 per cent of the dry weight of that soil.

(3) During dry seasons, like that of 1889, a sandy clay loam, supporting a crop of timothy and clover and underlaid by 2 feet of gravelly red clay, followed by quartz sand containing some gravel, may be so dried to a depth of 5 feet that the average water content is only 6.42 per cent of the dry weight.

Cases of slow downward movement.—On the morning of September 5, after a rain-fall of 1.14 inches, or 5.9 pounds, to the square foot, which occurred during the previous evening and night, it was found that in a corn field the rain had penetrated only 3 to 4 inches and in clover ground not more than 3 inches. Twenty-four hours later the water had reached 4.5 to 5.5 inches on the corn ground and 4.5 inches on the clover. On the morning of September 7, 62 hours from the beginning of the rain, the water had penetrated only 5.5 to 6 inches in the corn ground and 5 inches on the clover.

Lateral capillary flow of water in surface soil (pp. 145–147).—The experiments described in this article indicate that in the clay-loam soil used the lateral movement of the soil water was slow, and extended only about 3 feet.

Capillary movement of water in wet field soils (pp. 147–151).—This is an account of the results of observations made "to determine the rate of change in the water content of field soils following rains when the soils were near their points of saturation. * * * On June 6, 1890, 32 hours after a rain of 3.16 inches, or 16.46 pounds, per square foot, which was distributed over 4 days, samples of soil were taken from eight different localities, and the amount of water they contained determined. Samples were again taken from the same localities 72 hours later, and their water content determined with the following results:

"The change in the water content in 3 days ranged from 1.47 to 4.44 pounds per cubic foot for the first foot of soil and from 0.54 to 2.76 pounds for the second foot of soil. Other instances are cited to show that these rapid changes in the water content of soil are not exceptional, and they may extend to a depth of 3 feet or more. Other observations indicate that "as the ground becomes drier the rate of desiccation diminishes, so as to be even less where crops are growing than on naked ground."

Rate of capillary movement of water in clay loam (pp. 151, 152).—In 1889 a laboratory study was made of the rate of capillary flow of water through a fine quicksand which underlies a large part of the experiment farm, and the method and results are recorded in the Annual Report of the station for 1889. During 1890 a similar study was made on a clay-loam surface soil, also from the experiment farm. The general results of both series of observations are given in a table. In both instances there was a decrease in the rate of capillary movement as the level of the water below the surface was lowered.

The water capacity of undisturbed soils in fields (pp. 152, 153).

The water-holding power of soils, as determined by laboratory methods and generally quoted in standard works on agriculture, is so widely different from the conditions which exist in nature, as shown by field studies, that it becomes utterly misleading when applied in general practice. The highest percentages of water observed in any soils as taken from the fields at the experiment farm were: black marsh soil, 34.71; brick clay, 31.81; clay loam, 33.19; clay loam, 28.88. * * * Laboratory experiments by Trommer have given for similar soils the following percentages: moor earth, by Zenger, 105; loamy clay, 50; yellow clay, 68; quartz sand with rounded edges, 26.

The lateral and vertical extent of root feeding (pp. 153–160).—Under this head are recorded the results of observations on the extent to which different plants diminish the water content of the soil by root feeding, both laterally and vertically. Potatoes, oats, corn, clover, timothy, and blue-grass were used for these observations, and the results indicate wide variations in the extent of root feeding by different plants. The strong drying influence which growing vegetation exerts on the soil was clearly brought out by comparing the water content of fallow ground with that of soils on which crops were growing.

A method of taking samples of soil (pp. 160–162).—A method used by the author for the past 2 years is described and illustrated.

The instrument employed in this method consists of a thin metal tube, of a size and length suited to the special object in view, and provided with a point which enables it to cut a core of soil smaller than the internal bore of the tube and at the same time make a hole in the ground larger than its outside diameter.

COMPARATIVE VALUE OF WARM AND COLD WATER FOR MILCH COWS, F. H. KING (pp. 163–182). (See also Annual Report of the station for 1889, pp. 146–188).—In 1889 and 1890 experiments were conducted to ascertain "whether warming water for milch cows in winter produces a measurable increase in the milk yield over that of cold water, and if

so, whether this increase affects the volume simply, or the weight of the solids contained, to an extent which would make it remunerative, in general practice, to warm the water for cows."

In both experiments six cows were placed in stanchions side by side, upon a daily ration of 5 pounds of bran, 2 pounds of oats, and 6 pounds of hay, together with what dry-cut corn fodder they would eat up clean. The experiment of 1889 extended over 64 days, from January 21 to March 25, and that of 1890 over 80 days, from January 11 to March 31. Both years the cows were divided into two groups of three each, which received identical treatment, except that when one group of cows was getting water at 70° Fah. the other was given that at 32°. In the first experiment the time was divided into three periods of 16 days each, with intervals between them; in the second, into five periods of 16 days each, the first 6 being treated as preliminary. At the close of each of these periods the water temperatures were reversed, the cows which had been receiving water at 32° Fah. were given that at 70° Fah., and *vice versa*, the water being given once daily after the morning feed.

For the experiment of each year tabulated data are given relative to the milk yield during warm and cold-water periods; differences between the same; quantity of water drank; quantity of food eaten; quantity of fat and of solids not fat in the milk, in per cent and pounds, while on warm water and on cold water; influence of the temperature of the water on yield and quality of milk; daily fluctuations in the composition of the milk coincident with the quantity of water drank; the gain in amounts of milk, fat, and skim-milk produced on warm water during 120 days, and the extra amount of corn fodder eaten during that time; the financial statement and the weight of the cows; and for 1889 the amount of heat required of the cows to warm the water they drank; diagrams showing the daily fluctuations in the percentage of water in the milk coincident with the quantity of water drank; and the temperature of the air as compared with the percentage composition of the milk. The individual record for each cow is given in an appendix (pp. 254–267).

The results of the two experiments are summarized as follows:

(1) All the results of 1890, with but one exception, are in accord with those of 1889, differing only in their numerical values.

(2) In 1889 an average of 1.002 pounds of milk per cow daily was given on warm water more than on cold, or 6,23 per cent of the general average daily yield of 16.06 pounds; in 1890 an average of only 0.22 pound daily more on warm water than on cold water, or 1.06 per cent of the general average daily yield of 20.71 pounds.

(3) The mean average daily amount of water drank per cow in 1889 was 63.07 pounds of cold, or 8 per cent of the live weight of the animals, and 73.26 pounds of warm water, or 9.29 per cent of the live weight, which is 10 pounds per cow more; in 1890 it was 77.29 pounds on cold, or 8.08 per cent of the live weight, and 85.4 pounds on warm, or 8.92 per cent of the live weight, which is 8.11 pounds more on the warm water.

(4) Both years the cows ate more while on warm water than while on cold water; in 1889, 23.50 pounds daily on cold, or 2.98 per cent of the live weight of the animals, and on warm water, 24.31 pounds, or 3.08 per cent of the live weight, which is 0.74 pound of corn fodder per cow daily more on warm water. In 1890 the amounts stood; 28.77 pounds on cold water, or 3.01 per cent of the live weight, and on warm 29.185 pounds, or 3.05 per cent of the live weight, which is 0.42 pound of corn fodder per cow daily more on warm than on cold water.

(5) It took, in 1889, 1.54 pounds of solid food for a pound of milk on cold water, and on warm, 1.44 pounds. In 1890 the amounts stood, 1.41 pounds on cold and 1.39 pounds on warm water.

(6) An increase in the amount of water drank was both years associated with an increase in the amount of milk produced, and this was true whether the water was warm or cold.

(7) Both experiments are in accord in showing that an increase in the amount of water drank when the temperature remains the same is associated with an increase in the amount of water in the milk, but with only a very small increase in the total solids.

(8) An increase in the temperature of the water drank rather than an increase in the quantity of it, was both years associated with a relatively much larger increase in total solids produced.

(9) There was both years a daily fluctuation in the percentage of water in the milk associated with a fluctuation in the amount of water drank, the water in the milk being greatest following the days when most water was drank.

(10) In 1889 five cows showed a strong preference for water at 70° over that at 32°, but one cow showed an even stronger liking for the iced water; in 1890 there was no exception to the general preference for warm water.

(11) With but one exception the cows in 1889, while they ate less and drank less during the cold-water periods, weighed more at their close, and with but three exceptions they weighed less at the close of the warm-water periods. In 1890 no such relation occurred, but the cows, without exception, weighed more on the average while on warm water.

(12) In 1890, when the intervals between the two milkings were equal in length, all the cows gave both richer milk and a larger quantity of it in the morning.

(13) There was a mean shrinkage in the milk flow per cow during the experiment in 1889 of 9.56 per cent, and in 1890 of 5.55 per cent, or a mean for the eleven cows in round numbers of 7 per cent, while the normal herd shrinkage, as determined by the Dairy Association of Great Britain, would place it at 12 per cent, and as given by Dr. Sturtevant a little higher. In view of this and other facts it does not seem impossible that simply shifting the cows alternately from warm to cold water may have some effect in lengthening the period of lactation.

(14) With butter at 20 cents per pound, skim-milk at 25 cents per cwt., corn fodder at \$5 per ton, and a cost of \$15 for warming water 120 days for forty cows, the result shows a profit of \$26.40 in 1889, and a loss of \$5.98 in 1890, leaving as an average for the two years \$10.21 on a herd of forty cows.

(15) The smaller difference between the yields of fat on warm and on cold water in 1890 can not be attributed to a warmer winter, for the mean temperature of the months of January, February, and March, 1889, was 24.6° Fah., and for the corresponding period of 1890 it was 24.7° Fah., and both sets of cows were sheltered in the same barn.

PLAN OF A BARN FOR A DAIRY FARM, F. H. KING (pp. 183–192, illustrated).—A description of a cylindrical barn (92 feet in diameter) built in 1889 on a farm near Whitewater, Wisconsin, after plans prepared by the author. A cylindrical silo occupies the center of the structure, and around the silo are accommodations for ninety-eight cows. It is claimed that where a large barn is desired the cylindrical form is economical as regards both cost of construction and the expense of caring for the animals.

The construction of the barn is described in detail, and the advantages of the plan as regards effective ventilation, control of tempera-

ture, and economy of construction, are discussed. The last-mentioned point is enforced by a table showing the total outside surface, floor space, cubical contents, and animal accommodations of the buildings on three farms in Wisconsin, as compared with this cylindrical barn.

PREVENTION OF APPLE SCAB, E. S. GOFF (pp. 193–201, illustrated).—A reprint of Bulletin No. 23 of the station (See Experiment Station Record, Vol. II, p. 134).

COMPARATIVE VITALITY OF HULLED AND UNHULLED TIMOTHY SEED, E. S. GOFF (pp. 202–204).—In threshing timothy seed the hulls of from 5 to 50 per cent of the seeds are removed. To get light on the question, whether the vitality of the seed was impaired by its being hulled, germination tests with the Geneva seed tester were made at the station with samples of hulled and unhulled seeds of various ages (1880–89). The details of the test are given in a table in the appendix to the report (p. 267) and are summarized in this article. In every case the percentage of hulled seeds which germinated was greater than that of the unhulled seeds. And it appeared that the hulled seeds did not retain their vitality as long as the unhulled. "Whereas in the 1889 seed, 91 of the hulled seeds germinated to every 100 of the unhulled; in the 1880 seed, only 34 of the hulled seeds germinated to 100 of the unhulled." Incidentally, this experiment indicates that timothy seed may be fairly reliable up to 5 years of age, and after that deteriorate very rapidly. It was also observed that the time required for germination increased with the age of the seed. An experiment with a view to producing a hulless variety of timothy seed is to be undertaken at the station.

POTATOES, VARIETY TEST AND OTHER EXPERIMENTS, E. S. GOFF (pp. 205–213 and 268–273).—This includes articles on a test of varieties and on methods of planting, reprinted from Bulletin No. 22 of the station (See Experiment Station Record, Vol. II, p. 30), with the addition of tabulated data giving the details of the experiments. There are also reports on experiments in hill *vs.* drill planting, and the sprinkling of cuttings with land plaster. In the former two tubers or cuttings in a place, planted in hills 38 by 38 inches apart, were compared with one in a place, planted in drills 38 by 19 inches. "Single eyes, two-eye cuttings, half potatoes and whole potatoes were used. Ten duplicate series of eight rows each were planted, the experiment including eighty rows, each 50 feet long. The average merchantable yields of the ten series in bushels per acre are summarized in a short table, the complete data being printed in the appendix. * * * In two cases the hills gave the larger yields; in one, the drills; while in one the yields were practically the same. The unusually dry season would seem to have affected the hills more injuriously than the drills, as the roots of the hill plants may be supposed to have been less evenly distributed in the soil. This fact may give the more weight to the results. At any rate the conclusion is warrantable that, under the conditions, no loss of yield followed planting in hills."

In view of the claim that "sprinkling the cuttings of potatoes with plaster before planting causes them to vegetate with greater vigor and to yield a larger crop," this was tried for ten 50-foot rows of the Rose Seedling variety, half the cuttings planted being sprinkled with plaster. The details are given in tabular form. "No difference was discernible in the time or vigor of vegetation, nor in the date of maturity."

NOTES ON STRAWBERRIES, E. S. GOFF (pp. 213, 214, and 274).—Tabulated data are given for 16 varieties tested in 1889. As the result of this test the varieties are ranked in the following order: "*For market*—Warfield No. 2, Haverland, Jessie, Wilson, Sharpless, Burt Seedling, Eureka, Gypsy, Gandy, Welch, Charles Downing, Cumberland, Lady Rusk, Bubach No. 5, Cloud, Carmichael. *For home use*—Jessie, Haverland, Gypsy, Sharpless, Warfield No. 2, Eureka, Wilson, Gandy, Burt Seedling, Charles Downing, Welch, Cumberland, Bubach No. 5, Cloud, Lady Rusk, Carmichael.

"The Gypsy was the earliest variety, and the Gandy, Welch, and Carmichael gave the latest pickings."

COMPARISON OF ENSILING AND FIELD CURING OF INDIAN CORN, F. W. WOLL, M. S. (pp. 215–237).—"Three years ago investigations were begun at the station for the study of the losses incurred in the field curing of fodder corn, to compare the results thus found with the losses that have been shown to take place in the silo. Data are numerous as regards this latter point, the subject having been studied during the last 10 years by numerous investigators, both abroad and in this country. It has been found that fodder corn will lose from 10 to 20 per cent of its nutritive value during the ensiling period, the amount of the loss depending upon the quantity ensiled, the maturity of the corn, the manner of filling, and the conditions present in the silo, its shape, lining, whether perfectly air-tight or not, etc. On the other hand, the losses in curing fodder corn have been studied but little, not considering trials where necessary precautions for taking samples have not been observed, and which, therefore, are not much better than mere guesswork."

The record of the station's work in this line in 1889 includes experiments with (1) two tank silos filled with clover to ascertain the loss in weight of the silage; (2) the same silos filled with fodder corn to ascertain the loss in weight and in dry matter, crude protein, and ash in the silo; (3) four station silos filled with different varieties of corn to ascertain losses in dry matter, crude protein, and ash in the silo; and (4) with dry fodder from different varieties of corn to ascertain the losses in dry matter and crude protein in field curing.

(1) *Tank silos filled with clover.*—"Two round tanks, such as are commonly used for water reservoirs, 6 feet in diameter and 12 feet high, were placed upon the platform scales. Tank No. 1 was tarred on the outside, while No. 2 was covered on the outside with tin, soldered on

carefully." July 1, 1889, both tanks were filled with red clover. The silage in tank 1 was covered with tar paper, and about 8 inches of sawdust; that in tank 2 was not covered. The weight of the silage, as taken daily for 2 months, is recorded in a table. When the tanks were opened September 2 it was found that the 1,183 pounds of clover put into tank 1, had decreased to 950 pounds, a loss of 233 pounds, or 19.7 per cent; 190 pounds of the silage was unfit for use, leaving 760 pounds (64.2 per cent) of good silage. The weight of the silage in tank 2 had decreased from 1,142.5 to 660 pounds, a loss of 482.5 pounds or 42.2 per cent. There were 331.5 pounds of spoiled silage, leaving only 328.5 pounds (28.8 per cent) of good silage. The large percentage of silage spoiled in the second tank was thought to be due to the fact that as no covering was used and the mass of the silage was too small to become compact by its own weight, fermentation was favored by a relatively large supply of air.

(2) *Tank silos filled with fodder corn.*—The tanks above described were filled September 2, 1890 with white flint fodder corn, which was covered with tar paper and 8 inches of sawdust.

Tank 1 received matured corn, 1,622 pounds. The weight of the silage taken out December 10 was 1,485.5 pounds, a loss of 137 pounds, or about 8.5 per cent. The spoiled silage weighed 223 pounds, leaving 1,262.5 pounds of good silage. The total loss from ensiling was 359.5 pounds, or 22.2 per cent. Analysis showed that the loss in weight of dry matter was 26.1, of crude protein 30.2, and of ash 30.8 per cent. "These losses are rather large, owing to the small quantity of fodder ensiled; being mature and comparatively light, the corn did not pack as well as in the case of the green corn, and hence the greater loss. The silage contained 1.14 per cent lactic acid and 0.06 per cent acetic acid, or a total acidity of 1.20 per cent."

Tank 2 received green fodder corn, 1,779 pounds. The weight of the silage taken out was 1,667.5, a loss of 111.5 pounds, or about 6.3 per cent. The spoiled silage weighed 167 pounds, leaving 1,500.5 pounds of good silage. The total loss from ensiling was 278.5 pounds, or 15.7 per cent. The loss in weight of dry matter was 8.3, of crude protein 14.8, and of ash 12.7 per cent. The spoiled silage "was almost black, sticky, and here and there white moldy. The good silage was light green, of aromatic odor, very sour; after the good silage had been reached no signs of mold were seen, the silage in contact with the wall of the silo, and clear down to the bottom being all well preserved. * * * The silage taken out of the silo contained 1.49 per cent of non-volatile acids (lactic acid), and 0.23 per cent of volatile acids (acetic acid), or a total acidity of 1.72 per cent."

A table gives a partial analysis of the corn and silage used in these experiments.

The result of these two silo experiments teaches us, as has also been repeatedly shown in our other silo work at this station but never under strictly comparable con-

ditions, that the more watery the fodder ensiled the smaller is the loss of dry matter, but the greater the acidity of the silage obtained. The better a fodder will pack the smaller the loss caused through fermentation in the silo. For this reason, while the original method of weighting the silage may not be considered practical, it will preserve a greater portion of the fodder; it is, therefore, simply a question of which is the more expensive—the outlay and trouble of weighting the silage, or the greater waste of food materials in the silo. The difference may, however, be less pronounced in case of large, deep silos than with small or shallow ones, as the weight of the fodder with the former ones causes it to pack sufficiently.

(3) *Station silos filled with different varieties of corn.*—Four silos were filled in the fall of 1889. From three of these complete data regarding the loss of dry matter, protein, and ash were obtained. The silage from the fourth was used in a feeding experiment, which prevented the determination of the loss of dry matter.

Silo 4 was filled with Burrill & Whitman fodder corn at five different dates from September 3 to 12, and opened in December. More spoiled silage was found than in the case of silo 2 with rapid filling, and the quality of the silage was no better. A partial analysis of the corn and silage for each silo is given in a table. Data are given showing the difficulty of obtaining a correct estimate of the ash content of silage in a large silo.

The losses of dry matter for three silos amount to 18.0, 20.2, and 29.6 per cent, or on an average 22.6 per cent, while the average loss of crude protein was 14.2 per cent The losses of dry matter last year in the same silos amounted to 18.36, 16.72, and 12.7. per cent, on an average 15.94 per cent.* The manner of filling the silos was strictly the same both years, and the only difference that the writer can think of was the further advanced condition of last year's corn crop, on account of the drought. The tank experiments would seem to indicate that the maturer the corn, other conditions being equal, the greater the loss of dry matter in the silo.

The results, as regards the loss of dry matter and protein, obtained by the author and by Mr. Short in 1888 (See Wisconsin Station Reports for 1888 and 1889) are summarized in two tables. The results of three years' work at the station are summarized as follows:

	Put in silo.	Taken out.	Loss.	
			Pounds.	Per cent.
Total quantity—	*Pounds.*	*Pounds.*		
Of dry matter	35,602.3	28,320.7	7,281.6	20.5
Of crude protein	2,910.3	2,312.5	597.8	20.6

This gives the result of 3 years' work, with ten silo experiments in all. The average loss of dry matter found by us to occur in the silo amounts to 20.5 per cent, or one fifth of the fodder put into the silo. This loss is practically identical with what has been called shrinkage by some experimenters; the shrinkage has been slightly increased in our calculations on account of the quantity of silage that spoiled on top of the silo, which being considered unfit for cattle food has not been credited to the silage; but the results would have been but little changed if only the actual decrease in weight had been considered. We thus must calculate on a decrease in weight of about one

*Wisconsin Station Report, 1889

fifth of the silage; that is, if a farmer puts into his silo 100 tons of fodder corn, he can not, as a rule, get more than 80 tons out of it; as the silage taken out of the silo contains a similar percentage of water as the fodder put into the silo, it is evident that the loss is not due to mere evaporation of water. This loss may be found to be somewhat smaller where large quantities of fodder are ensiled; in our work we have ensiled only from 8 to 12 tons, which are about the largest quantities ensiled for experimental purposes, the results of which have been made public, as far as my knowledge goes. At the Pennsylvania and Missouri Stations, in experiments where 17 and 14 tons of fodder corn, respectively, were ensiled, the losses of dry matter were 13.44 and 16.85 per cent (See Agricultural Science, 1890, p. 145).

Field-cured corn.—Two experiments were made. (1) Seventy-eight shocks of the same varieties (Pride of the North, Burrill & Whitman, and Sibley's White Flint) as those used in the silos, were cut at the same time as for the silo and left in the field about a month, after which they were stored in the loft of the station barn until fed to cattle. A table gives the weights of fodder shocked in each case, and the weight as fed out to cattle.

Samples taken from time to time as the fodder was fed to the cattle were united after the content of dry matter had been ascertained, and the protein content determined in the mixed samples for each variety. A table gives the result of the analysis, and the losses of dry matter and protein in the cured fodder. * * * The losses of dry matter varied from 7.9 to 30.7 per cent, with the three varieties, and of protein from 2.2 to 41.0 per cent. The result with Burrill & Whitman fodder corn is far lower than any other found in this work, and it is believed that an error of sampling must have crept in, most likely in the sampling of the green fodder. * * *

Six varieties of fodder corn, grown at the University farm on small plats, were cut and shocked September 4 to 17, and samples representing the fodder grown on each whole plat were taken for analysis. * * * The varieties sampled were Pride of the North (dent), King Philip (flint), Sweet Fodder, Stowell's Evergreen, Southern Sheep's Tooth, and Southern Horse-Tooth fodder corn. The shocks were left on the plat on which the fodder had grown, except in the case of sweet fodder corn, where half the number of shocks were transferred at once after cutting to an empty corn crib, where the shocks were put up in a similar way as the rest of the fodder was shocked on the plat. The object in view was to ascertain the losses in food materials occurring on account of the air drying under a shelter from rain and storms. * * * At intervals of a month the shocks on the plats were removed, one or two at a time. The shocks were then weighed and run through a feed cutter and the whole shock sampled. The weight of each shock being known, and also its composition at the time it was put up, all data are at hand from which to determine the decrease of dry matter and its constituents during the average time each variety was left exposed. In our work only the crude protein could be determined besides the dry matter on account of the pressure of other work. * * * The varieties shocked, the stage of growth they were in, dates of cutting, etc., are stated, and the total quantities of dry matter and of crude protein found by analysis to have been on each plat at the time of shocking and when the shocks were sampled, are given [in a table, together with] the losses which took place in the shocks during the time of exposure. * * * [The losses of dry matter and protein found in samples of Sibley's White flint and Smedley's Yellow dent corn stalks left standing in the field uncut for 4 months are also given in a table.] * * * The amount of losses given in the tables will doubtless surprise many, as it did the writer. It is believed that nearly all points bearing on the field curing of Indian corn are covered by the data given—differences in the size of shocks, shelter from rain and storms, or exposure to the same for a shorter or longer period, husked or unhusked fodder corn, etc.

The amount of rain-fall and snow during the fall and winter of 1889–90 was small, thus favoring the curing of fodder. The losses of nutrients in the fodder are, therefore, probably below the average. In the case of the sweet fodder corn shocked in the corn crib the loss of dry matter was 8.2, and of protein 13.7 per cent; shocks of the same variety left in the field showed a loss of 15.6 per cent of dry matter and 22.7 per cent of protein.

The highest losses come, as would be naturally expected, where husked fodder is shocked. Stowell's Evergreen, as an average of the results with ten shocks, gave a loss of 33.9 per cent of dry matter, and 29.2 per cent of protein. Pride of the North, lot B, gave 13.9 per cent loss of dry matter and 19.3 per cent of protein against 20.6 per cent and 13.7 per cent of dry matter and protein, respectively, where the shocks were husked. Another point is noticeable: where unhusked fodder is shocked the loss in per cent of protein exceeds that of dry matter, except in the case of Southern corn, where the proportion of nutriments in the ears, if there be any, with us is very small compared with what is in the leaves and stalks; where husked fodder is shocked the loss of dry matter exceeds that of protein. This might be inferred from the fact that the ears are made up largely, from non-nitrogenous bodies, especially starch, which it is not likely to suppose will be as easily subject to fermentation processes as the constituents of the stalks and leaves, being better protected than these.

The results found in regard to losses in field curing of Indian corn show conclusively that fodder corn in curing and being shocked is constantly deteriorating in nutritive value, in a similar way as has been found in case of the ensiling process. The amount of this loss will vary more with shocked corn than with ensiled corn, for the reason that with the corn in the silo we have all conditions more under our control, and are independent of the changes of the season.

The results of these experiments in 1889 and of these and similar experiments for 3 years are summarized in tables.

Tabulating the results obtained at this station during the last 3 years in regard to the losses of dry matter and protein in the ensiling and field curing methods of preserving Indian corn, we have the following summary:

Total quantities of ensiled and shocked fodder corn.

	Green fodder.	Silage or dry fodder.	Loss.	
			Pounds.	Per cent.
(*a*) Ensiling method (summary of 3 years' work, ten experiments):	*Pounds.*	*Pounds.*		
Total quantity of dry matter	35,602.3	28,320.7	7,281.6	20.5
Total quantity of crude protein	2,910.3	2,312.5	597.8	20.6
(*b*) Field-curing method (summary of 3 years' work):				
Total quantity of dry matter	39,448	31,428	8,020	20.3
Total quantity of crude protein	3,102.2	2,619.7	482.5	15.6

While the average losses of dry matter in the ensiling and in the field-curing system have thus been found to be very nearly the same, the loss of protein is lower in the latter system. The loss of food materials in either system is very considerable, and shows that we are unable to preserve our fodders by any method now known without their deteriorating in value. * * *

The problem of the proper method of preserving fodder corn then is narrowed down to this: In the fodder corn as it is cut in the fall there is a certain quantity of food elements that may be preserved in a succulent state in the silo or cured and fed to

cattle as dry fodder. In either case an equal quantity of the food materials is destroyed, on an average about one fifth. * * * This loss being equal in either case, the question of which method of preserving fodder corn to adopt becomes one of convenience and economy of feed. As will be seen in the discussion of the feeding trials with silage and dry fodder, the value of these feeding stuffs is about the same for milk and butter production, and hence the adoption or non-adoption of the silo must be decided on the score of convenience. In some localities the conditions may be more favorable to the field-curing system, while in others the uncertainty of weather, the cheapness of lumber, or the severity of winter may speak strongly in favor of the system of ensiling the fodder corn.

NUMBER AND SIZE OF FAT GLOBULES IN COWS' MILK, F. W. WOLL, M. S. (pp. 238–247).—A popular discussion of this subject, together with a tabulated record of microscopical examinations of the milk of 4 cows each month during the past year, and a tabulated statement of the number and size of globules in the milk of 4 different cows before and after calving.

The author states that "the number of globules increases and their size decreases with advancing lactation;" and that "the stage of the lactation period seemed to be of greater importance than the breed or individuality of the cow in determining the size of the globules."

"A disturbance of any kind, hard treatment, excitement, sickness, etc., will leave its mark on the number and size of globules, and hence influence the creaming qualities of the milk and the rapidity and completeness with which the churn will do its work. Succulent foods seem to diminish the size of the globules and increase their number."

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY.

INSECT LIFE, VOL. III, NO. 4, NOVEMBER, 1890 (pp. 131-178).—The principal articles in this number are: Report on a local outbreak of grasshoppers in Idaho, by L. Bruner; on the use of contagious diseases in contending with injurious insects, by H. Osborn; a new and remarkable Encyrtid, is it parasitic? by L. O. Howard; notes on garden insects, by F. M. Webster; some of the bred parasitic *Hymenoptera* in the National Collection (continued); notes upon *Ephestia interpunctella* (Hübn.) Zeller, by W. H. Patton; notes upon some insects affecting corn, by F. M. Webster.

INSECT LIFE, VOL. III, NO. 5, JANUARY, 1891 (pp. 179-250).—This comprises the proceedings of the second annual meeting of the Association of Economic Entomologists, held at Champaign, Illinois, November 11-13, 1890. A list of the papers read at this meeting was published in Experiment Station Record, Vol. II, p. 269.

DIVISION OF VEGETABLE PATHOLOGY.

JOURNAL OF MYCOLOGY, VOL. VI, NO. 3 (pp. 89-135, illustrated).—This number includes the following articles: Experiments in the treatment of plant diseases, Part I—treatment of black rot of grapes, by B. T. Galloway and D. G. Fairchild; diseases of the grape in Western New York, by D. G. Fairchild; anthracnose of cotton, by E. A. Southworth; perennial mycelium of the fungus of blackberry rust, by F. C. Newcombe and B. T. Galloway; field notes, by E. F. Smith; the relationship of *Puccinia* and *Phragmidium*, Professor G. de Lagerheim; notes on a new pear disease (*Thelephora pedicellata*, Schw.), a disease of geraniums, anthracnose of the hollyhock, *Leptothyrium perichymeni*, Desm., and a a new *Ustilago* from Florida; reviews of recent literature; new species of *Uredineæ* and *Ustilagineæ*, by J. B. Ellis and B. M. Everhart; notes on certain *Uredineæ* and *Ustilagineæ*, by F. W. Anderson; index to North American mycological literature (continued), by D. G. Fairchild.

ABSTRACTS OF REPORTS OF EUROPEAN INVESTIGATIONS.

Germination of the Jerusalem Artichoke (Helianthus tuberosus), J. R. Green (*Ann. Agron.*, 15, *p.* 569; *Centralblt. f. Agr. Chem.*, 19, *p.* 716).—The tubers of the Jerusalem artichoke were found by the author to develop during germination a ferment which changes inulin into a sugar. The ferment is present in the tubers in small quantities and only during germination, but it may be artificially formed by heating the tubers during 24 hours at 35° C., and may be extracted by glycerine. Boiling destroys its activity. It is not identical with diastase; and saliva has no action on inulin.

The sugar formed by this new ferment does not crystallize, and reduces less readily than lævulose or dextrose. An intermediate product is formed during the change which is more soluble in cold water and dialyses more easily than inulin, crystallizes characteristically, and requires 82 per cent alcohol to dissolve it, while inulin is soluble in 65 per cent alcohol.

Transformation of the alkaloids during germination, E. Heckel (*Compt. Rend.*, 110 (1890), *p.* 88; *Journ. Royal Mic. Soc.*, 1890, *p.* 633).—The author concludes from observations made chiefly with strychnine, brucin, daturin, and caffein, that the alkaloids in seeds are true reserve food materials, since they are entirely transformed into assimilable substances during germination. The alkaloids contained in the cotyledons or in the embryo had in all cases completely disappeared as soon as the seedlings had attained a considerable size. The results of the transformation of caffein were found to be glycophyl and potassium nitrate.

Formation of nitrates in plants, Serno (*Landw. Jahrb.*, 18 (1890), *pp.* 877–905).—Nitric acid was found in almost all families of plants, the largest quantities occuring in the *Malvaceæ*, *Cruciferæ*, *Papaveraceæ*, *Convolvulaceæ*, *Labiatæ*, *Compositæ*, and *Urticaceæ*. In many plants it occurs only in the roots, especially in the newly formed absorbing roots; and in no case was it found in roots living in symbiosis with fungi. In many perennial plants the nitrates are stored up in the roots during winter as a reserve material; in others they are formed only in the spring. In annual plants they occur abundantly in all parts. The nitric acid taken up by plants is believed by the author to be used in the formation of amides, especially of asparagin.

Saccharine substances contained in fungi, M. R. Ferry (*Rev. Mycol.*, 12 (1890), *pp.* 136–40. *Journ. Royal Mic. Soc.*, 1870).—The conclusions drawn from numerous analyses showed that: (1) Mannite is nearly always present in the larger fungi, crystallizing in long, fine needles; (2) trehalose is less frequently present, and may be known by its hard, massive crystals; (3) chloride of potassium is present in some species of the genus *Amanita*; (4) glucose is met with in *Amanita valida*, *A. spissa*, *A. mappa*, *Tricholoma sulfureum*, *Russula virescens*, etc.

The behavior of sandy soils toward superphosphates, A. Thomson (*Centralblt.*, *f. Agr. Chem.*, 19 (1890), *pp.* 585–588).—From laboratory experiments the author concludes that the action of superphosphates in sandy soils is very slight except where considerable quantities of calcium carbonate, or small amounts of calcium carbonate and the sesquioxide of either iron or aluminum are present, and at the same time no considerable amount of nitrates are either applied to or formed in the soil.

Effects of different fertilizers on the quality of tobacco, Adolf Mayer (*Landw. Versuchs-Stationen*, 38, *pp.* 92–126).—A series of experiments were made on 12 fortieth-acre plats, 11 being fertilized with various combinations of barn-yard manure, nitrate of soda, caustic ammonia, superphosphate, Thomas slag, potash, and double sulphate of potash and magnesia, and one remaining unmanured. On part of the plats the barn-yard manure was applied in the fall, and on part in the spring at the time the land was prepared.

The plats fertilized with artificial fertilizers yielded about twice as much, and those receiving barn-yard manure about three times as much as the one remaining unmanured. With regard to cost of fertilizer per kilogram of product, the chemicals in several instances compared favorably with the manure. The result was decidedly better where the barn-yard manure was applied in the fall than in the spring. The plants responded better to the application of nitric acid than to ammonia fertilizers. Thomas slag gave favorable results, as did also potassium carbonate which was compared with potash-magnesium sulphate.

With regard to combustibility, which was determined by lighting a piece of torn leaf, extinguishing the flame, and noting the number of seconds till the glowing ceased, tobacco from plats receiving a fall application of barn-yard manure glowed the longest, while that from plats fertilized with chemicals was about equal in this respect to that from the unfertilized plat. The application of barn-yard manure in the spring seemed to exert a decidedly unfavorable influence on the burning quality. This is explained by the fact that when the manure was applied in the fall there was more opportunity for nitrification, and that this increased the nitric acid in the leaf. Thus, with the fall application the leaves contained 0.76 to 0.8 per cent of nitrogen as nitrates, and with the spring application, 0.15 to 0.22 per cent. Potassium carbonate was decidedly favorable as compared with potassium-magnesium sulphate.

No advantage was ascribable to Thomas slag compared with the superphosphate.

The determinations of nitrogen compounds include those of the total nitrogen, nicotine, nitric acid, and ammonia. The total nitrogen was greater from the fall than from the spring applications of barn-yard manure; and was unusually small in the product from the unfertilized plat. Applications of nitrates increased not only the total yield of tobacco, but also the percentage of total nitrogen in the leaf. In general the largest per cent of nicotine occured where barn yard manure had been applied. In no instance was a high nicotine content found where the supply of plant food had been insufficient; the smallest percentage was found in the product from the unfertilized plat. Applications of ammonia seemed the most favorable to the production of a high nicotine content.

Where nitrogen was either entirely wanting in the fertilizer, or was applied in the form of ammonia, a constant percentage of 0.04 nitrogen as saltpeter was noticed in the product; this small amount seemed necessary to the existence of the plant.

The color seemed to be considerably influenced by fertilizers, a luxuriant growth inducing a darker color. In general the color was lighter or darker in proportion as the nicotine content was higher or lower. The author observed that often with application of Chili saltpeter a spotted leaf was produced, evidently because plants thus fertilized cured more slowly and unevenly.

The following are among the practical conclusions drawn by the author from this and previous observations. The use of artificial fertilizers alone, even on a soil rich in humus, is not advisable. A liberal application of barn-yard manure must for the present remain the basis of tobacco culture, at least in Europe. In cases where tobacco is grown year after year green manuring with rye may be practiced, especially in times of low prices. As supplements to insufficient natural supplies of manure, according to the needs, either Chili saltpeter, superphosphate, or potassium-magnesium sulphate, or a combination of these, applied shortly before the setting of the plants, is recommended.

(With reference to the burning qualities of the leaf, it is recommended that the first year a piece of land is used for tobacco the barn-yard manure be applied several months previous to the setting of the plants; and regarding the use of artificial fertilizing materials, to use those containing no chlorides or sulphates and those which contain an excess of incombustible basic constituents, that is, saltpeter for the nitrogen source (not ammonium sulphate, treated Peruvian guano, or gas water); double superphosphate, bicalcic phosphate and Thomas phosphate (better than common superphosphate) for the phosphoric acid supply; and wood ashes or carbonate for the potassium.)

The color may be in a measure influenced by the nature and extent of the fertilizers applied. Strong applications of nitrogenous manures

induce a dark color, and Chili saltpeter is liable to cause a green-spotted appearance of the leaves when dried.

Decrease in sugar content of beets in keeping, G. Marek (*Deutsche landw. Presse*, 17 (1890), *p.* 310; *Centralblt. f. Agr. Chem.*, 19, *p.* 619).—The author finds that the larger the percentage of sugar in the beet, the greater the decrease in keeping; and that this decrease is greater at a high temperature than at a low one. The differences in the rate of decrease in the sugar of two beets containing the same amount of sugar at the time of harvest, he attributes to the differences in amount of non-saccharine substances present, the larger the amount of these, the greater being the decrease in sugar. Attention is called to the importance of this in selecting sugar-beets for raising seed. Contrary to views generally held, he finds that beets stored in the ordinary way suffer a greater loss of sugar by keeping over winter than those which are preserved with the tops on.

Calorimetric investigations on fats and fatty acids, F. Stohmann and H. Langbein (*Journ. f. prak. Chem.*, 42 (1890), *pp.* 361–382).—Recent repetition of former investigations by the authors shows, as before, that the fats in the tissues of swine, sheep, oxen, horses, men, dogs, geese, and ducks, all have the same "heats of combustion," those for butter fat being somewhat lower. It was also found that in proportion as the fats became rancid their heats of combustion decreased, and that oxyacids were formed in this process. These facts led the author to suggest that the variations in heats of combustion may be due to the formation of these oxyacids.

Digestibility of hay, bean meal, barley meal, Swedish turnips, and rice meal, F. Lehmann and J. H. Vogel (*Journ. f. Landw.*, 38 (1890), *pp.* 165–197).—The experiment was carried out with two sheep. The plan followed was that of determining the digestibility of the nutrients of the hay alone in one period; that of the bean meal in another period by feeding it with hay; and then, with these two materials as a basis, adding barley meal, rice meal, and Swedish turnips each in separate periods, and from the increased amount of nutrients digested over that when bean meal and hay were fed, calculating the co efficients of digestibility for each feeding stuff. As the rice meal, Swedish turnips, and barley meal are low in protein content, each was tested separately with the basal ration of hay and bean meal to furnish the desired relations of coarse to concentrated feeds, and to make the nutritive ratio about 1:5. The rations during the six periods were as follows:

Period 4, meadow hay.
Period 1, meadow hay and bean meal.
Period 2, meadow hay, bean meal, and Swedish turnips.
Period 5, meadow hay, bean meal, and rice meal.
Period 6, meadow hay, bean meal, and barley meal.
Period 3, meadow hay, bean meal, barley meal, and Swedish turnips.

The following are the results found:

Co-efficients of digestibility.

	Dry matter.	Crude protein.	Albuminoid protein.	Crude fat.	Crude cellulose.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Hay	62.24	53.36	45.8	42.93	60.71	67.68
Bean meal	80.02	88.64	78.2	49.05	....	88.76
Swedish turnips	96.28	62.26	30.4	93.46	100	99.05
Barley meal	90.80	63.17	62.2	77.84	100	96.16
Rice meal	66.02	44.45	39.5	83.15	34.87	83.84

The co-efficients of digestibility given by E. Wolff* for barley meal and rice meal are as follows:

	Organic matter.	Crude protein.	Crude fat.	Crude cellulose.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Barley meal	81	77	100	00	87
Rice meal	89	77	88	67	100

The figures given by Wolff for barley meal are based on experiments by M. Maercker and E. Schulze and were not regarded by them as altogether conclusive. The nutritive ratio of the ration (hay and barley meal) used by them was 1: 8.4, while that of the mixture of meadow hay and barley meal fed by the authors was, as given above, 1:5. Experiments in artificial digestion showed that the co-efficients found for protein in the trial with sheep were not too low. The unusually high co-efficient found for crude cellulose the authors believe to be traceable to an error in the co-efficient for the cellulose of bean meal. If this had been estimated too low, when barley meal came to be fed in connection with it the cellulose digested above the amount previously observed would be attributed to the barley meal and would go to increase the co-efficient from that material. The authors believe that the results with rice meal are a true example of "depression in digestibility," which may account for the unsatisfactory results from time to time obtained from this product in practice and that a more careful feeding would probably show a higher rate of digestibility. No decrease in the digestibility of Swedish turnips was noticed where the amount fed was increased so that they supplied 52 to 54 per cent of the total dry matter of the ration.

In the course of the experiment the following facts were also observed: On an average a South Hanover sheep weighing 31.5 kilograms (69.3 pounds), kept at a stall temperature of 10.1° C. (50° Fah.), required for maintenance 74.1 grams of protein, 8.8 grams of fat, 70.5 grams of cellulose, and 301.4 grams of nitrogen-free extract per day. No difference was brought out in this trial between cellulose and easily soluble carbohydrates in their action as protein economizers.

*Mentzel und v. Lengerke, Landw. Kalender, 1890, p. 112.

The influence of steaming on the nutritive value of lupine, S. Gabriel (*Journ. f. Landw.*, 38 (1890), *pp.* 69-90).—In treating lupine with steam under pressure, as is often done to remove its bitter taste and otherwise prepare it for feeding, changes take place in the food constituents which may effect their nutritive value. In the experiment here described, the lupine was heated with steam at 140° C. during 4 hours.

An examination showed 100 parts of the protein of the lupine before and after steaming to contain nitrogen in the form of—

	Albuminoids.	Peptons.	Amides.
	Per cent.	*Per cent.*	*Per cent.*
Before steaming	92.80	2.60	4.60
After steaming	74.26	13.33	12.44

A digestion experiment with sheep gave the following results:

Co-efficients of digestibility of raw and steamed lupine.

	Organic matter.	Crude protein.	Crude fat.	Crude cellulose.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Lupine before steaming	80.92	86.97	76.20 and 66.27	77.18	75.95
Lupine after steaming	67.89	67.07	89.16 and 78.22	68.92	65.87

The digestibility is, according to this experiment, considerably diminished by the steaming process. The author attributes this to the high temperature of the steam, as two samples of fibrin prepared from blood, which tests showed to be almost entirely digestible, were found after being heated at 115° C. during 8 hours to have diminished in digestibility in pepsin solution to 59 and 65 per cent, respectively. The author suggests that this may have been due to the giving off of water accompanying a decomposition of the material. A curious fact is that while the daily ration of raw lupine contained 12.44 grams of digestible albuminoid and 0.7 gram of non-albuminoid nitrogen, against 8.25 grams of albuminoid and 1.88 grams of non-albuminoid nitrogen in the steamed food, the amount of nitrogen laid on in the body by the animals was more while the steamed lupine was fed (2.75 grams) than with the raw lupine (2.39 grams). While it is well known that asparagin can act as an albuminoid economizer, this material could not have been formed at the temperature of the steaming process, and could not account for so great differences if it had been present.

The results would indicate that a mixture of albuminoids and amides may possess a higher nutritive value than pure albuminoids containing a like amount of nitrogen; and the author suggests that little-known amide bodies may play a most important part in nutrition.

Limit to the assimilation of sugars, F. Hofmeister (*Centralblt. f. d. Med. Wissensch.*, 28 (1890), 244; *Centralblt. f. Agr. Chem.*, 19 (1890), p. 716).—The author made experiments on small dogs, and found that with the

same animal tested at different times, the limit of assimilation for a dog weighing from 2.5 to 3.6 kilograms (5.5 to 7.9 pounds) was for cane sugar about 10 grams; dextrose, 5 grams; milk sugar, one half gram; galactose, one half gram. The limit was nearly the same with the same animal and the same sugar at different times.

Galactose and milk sugar passed into the urine much more readily than dextrose, lævulose, or cane sugar.

Influence of the addition of protein to a maintenance ration on the metabolism in full-grown animals. Prepared by W. Henneberg and Th. Pfeiffer, on the basis of investigations by E. Kern and H. Wattenberg (*Journ. f. Landw.*, 38 (1890), pp. 215–279).—The experiment was made with two full-grown sheep and extended over 7 periods of 3 weeks each. The maintenance ration consisted during the whole experiment of 800 grams of hay and 200 grams of barley meal per animal daily. This ration was fed alone during periods 1 and 7. There were added to this ration during periods 2, 3, and 4, respectively, 70, 140, and 210 grams of conglutin from lupine; and during periods 5 and 6, respectively, 152 and 76 grams of ground meat from which the fat had been thoroughly extracted. The liquid and solid excrement was collected during the last 2 weeks of each period, and for 2 days during this time the production of carbonic acid per 24 hours was determined by means of a respiration apparatus. While the results are not considered by the authors as altogether conclusive, they in part corroborate previous observations, and are highly instructive. The following brief summary gives the quantities of nutrients digested, and the quantities of protein and fat stored in or lost from the body.

Average results per sheep daily.

Averages of periods.	Nutrients digested.						Materials laid on (+) or lost (—) from the body.			
	Total amounts digested.			More (+) or less (—) digested when protein was added than when on the maintenance ration (1 and 7).			Total amounts.		Excess of materials laid on over those with maintenance ration (1 and 7).	
	Protein.	Fat.	Nitrogen-free extract, including cellulose.	Protein.	Fat.	Nitrogen-free extract, including cellulose.	Protein.	Fat.	Protein.	Fat.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams*	*Grams.*	*Grams.*	*Grams.*
1 and 7	50.52	10.80	455.51	......	......	......	—4.11	+9.83	....	....
2 and 6	107.08	10.17	451.62	+55.56	—0.63	—3.89	—0.78	+29.76	3.33	19.93
3 and 5	164.06	10.03	455.49	+113.54	—0.77	—0.02	+5.58	+41.28	9.64	31.40
4	214.78	10.79	456.90	+164.26	—0.01	+1.39	+21.47	+52.83	25.58	43.00

The proportion in which the nutrients replace one another in serving as fuel in the body is believed to correspond with their potential energy. The authors use the averages given by Rubner,* according

*Zeitsch. f. Biologie, 19, p. 313.

to which 100 parts of fat are equivalent to 211 parts of albuminoids, and 100 parts of carbohydrates equivalent to 88 parts of albuminoids. Calculated on this basis, the protein-equivalents for the amounts of fat and carbohydrates digested in excess of the average amount digested in periods 1 and 7 (maintenance ration), would be for periods 2 and 6 as follows:

	Grams albuminoids.
—0.63 grams fat × 2.11 =	1.33
—3.89 grams carbohydrates × 0.88	3.42
Total	4.75

That is to say, the 0.63 grams of fat and 3.89 grams of carbohydrates lost from the body were equivalent to 4.75 grams of protein. In the same way, the fats and carbohydrates lost in periods 3 and 5 were equivalent to —1.64 grams of protein, and those gained in period 4, + 1.20 grams of protein.

In order to determine the actual effect of the added protein, the calculated protein equivalents must be subtracted from or added to the excess of digested protein over that of the maintenance ration, as given in the above table. This gives the actual excess of nutrients, expressed in terms of protein (protein-equivalent), digested from the food during periods in which protein was added, over that digested from the maintenance ration fed in periods 1 and 7, as follows:

Averages per animal daily.

Averages of periods.	Excess of protein (protein-equivalent) digested when protein was added, over that digested from the maintenance ration (periods 1 and 7).	Excess of materials laid on over those with the maintenance ration (periods 1 and 7).	
		Protein	Fat.
	Grams.	*Grams.*	*Grams.*
2 and 6	(55.56—4.75=) 51.81	3.33	19.93
3 and 5	(113.54—1.64=) 111.90	9.64	31.40
4	(164.26+1.20=) 165.46	25.58	43.00

For the 51.81 grams of protein (protein-equivalent) in excess of that contained in the maintenance ration, 3.33 grams more protein and 19.93 grams more fat were stored in the body (laid on) than with the maintenance ration, etc.

If the amount of protein laid on is subtracted from the amount digested, the remainder would be the amount of protein which served to lay on fat, and from this the amount of fat laid on for each 100 grams of protein digested can be calculated by proportion. Thus, in periods 2 and 6 (51.81 — 3.33 =) 48.48 grams protein produced 19.93 grams fat; therefore, 48.48 : 19.93 : : 100 : 41.11 grams, or the amount of fat laid on per 100 pounds of protein. A similar calculation gives the relative amounts of albuminoids and fat laid on for each 100 grams of protein (protein-equivalent) consumed.

Materials stored in the body per 100 grams of protein digested.

Averages of periods.	Amount of fat produced per 100 grams of digested protein (protein-equivalent in excess of that of the maintenance ration, periods 1 and 7).	Amount of protein and fat produced in the body per 100 grams of digested protein (protein-equivalent in excess of that of the maintenance ration). Protein.	Fat.
	Grams.	*Grams.*	*Grams.*
2 and 6	41.11	6.43	38.47
3 and 5	30.70	8.61	28.06
4	30.73	15.46	25.98
Average of all	34.18	10.17	30.83

The authors state that the results point strongly toward a tendency in the animal organism to increase the amounts of protein laid on when the protein in the food is increased. This is indicated by the above table. The amount of fat laid on decreases, on the contrary, with the increase of albuminoid food, that for period 4, when the largest amount of protein was fed, being the lowest.

According to Henneberg, under the most favorable circumstances 100 grams of albuminoids may cause a production of 51.39 grams of fat in the animal body. The above table shows a production of 41.11, 30.70, and 30.73 grams of fat per 100 grams of albuminoids digested, which indicated that albuminoids added to the maintenance ration and fed to grown animals are worked over in the animal organism with a relatively small loss.

Whether the average amounts of protein and fat produced per 100 grams of protein-equivalents, as given above (10.17 grams albuminoids and 30.83 grams of fat), can be regarded as a correct ration for all cases, irrespective of the amount of protein added to the maintenance ration, or whether 50 grams would produce a relative amount different from that produced by 150 grams, the authors are not prepared to say.

Observations made on the secretion of urine and on the production of carbonic acid showed that the shearing of the sheep had no effect on the metabolism of the food.

Comparison of hay, rice meal, and Swedish turnips in fattening sheep, F. Lehmann and J. H. Vogel (*Journ. f. Landw.*, 38 (1890), pp. 199–214).—In a stall experiment with two sheep, Swedish turnips produced a relatively larger increase in live weight than either rice meal or hay (mixed grasses). Whether this was due to the fact that, possessing a higher rate of digestibility, the roots required less work on the part of the digestive organs to obtain a given amount of digested materials, or to other causes, the authors do not attempt to say.

Observations on the milk of cows of different breeds, W. Kirchner (*Milch Zeitung*, 19 (1890), pp. 761–765).—Analyses of the milk of three cows, Simmenthaler, East Friesian, and Jersey breeds, made twice each week

during a feeding period lasting nearly a year, showed the Jersey's milk to contain twice as much fat as that from the East Friesian cow. The butter from the Jersey milk came quickest, was superior in hardness, aroma, and taste, and possessed the highest melting point. The highest melting point was found in butter from milk containing the largest fat globules—Jersey. In previous experiments this was true of butter from milk containing the smallest fat globules, and the author suggests that the melting point may have been influenced by the stage of the milking period.

Bacteriological examinations of milk, J. Clauss (*Diss. Würzburg; Chem. Centralblt.*, 1890, p. 518).—The author isolated from the milk under investigation five typical forms of bacteria, which he describes. The acidity of the milk examined increased with the number of bacteria it contained. Bacteriological examinations give no criterion as to the purity of milk, at least in winter. All investigations go to show that the greatest cleanliness should be observed in milking.

Of the bacteria occurring in milk, the lactic-acid bacillus withstands the greatest extremes in temperature.

The optical analysis of butter, C. Viollette (*Compt. Rend.*, 111 (1890), p. 348).—The index of refraction for butter and margarines is said to be very different in the oleofractometer, that for butter being between -33° and -28°, and for margarine between -15° and -8°. As the refractometer is reliable in case of mixtures, it now remains to fix the minimum refraction for butter below which it can be pronounced with certainty to contain admixtures of margarines.

EXPERIMENT STATION NOTES.

ILLINOIS STATION.—S. A. Forbes, Ph. D. professor of zoology and entomology in the Illinois University, and State entomologist, has been appointed consulting entomologist of the station.

IOWA STATION.—James Wilson has been elected director of the station, vice R. P. Speer.

KANSAS COLLEGE AND STATION.—The college is holding a series of farmers' institutes this winter, in which the experiments of the station are explained.

MAINE COLLEGE AND STATION.—W. M. Munson, B. S., of the New York Cornell Station, has been appointed professor of horticulture in the Maine College and Station.

MARYLAND STATION.—This station will hereafter give more attention to the study of the soils of the State. This work will be in charge of Professor Milton Whitney, formerly of the South Carolina College and Station. As a basis of the work a preliminary geological map of Maryland has been compiled by Professor Whitney, who has received much assistance in this line from the United States Geological Survey and Johns Hopkins University. The latter institution has also generously provided a laboratory in Baltimore for use in these soil investigations.

MICHIGAN STATION.—The following changes have taken place in the state board of agriculture, which is the governing board of the station. Hon. E. B. Winans, governor of the State, has taken the place of Hon. C. G. Luce, the former governor. Henry Chamberlain, of Three Oaks, and Edwin Phelps, of Pontiac, have been appointed members of the board; and O. Palmer, of Grayling, and C. H. Spencer, of Flint, have resigned from the board. Arthur G. Blackstein, M. D., has been appointed pathologist of the station and will devote himself to the study of animal diseases.

NEW HAMPSHIRE COLLEGE AND STATION.—C. M. Weed, M. S., of the Ohio Station, has been appointed professor of zoology and entomology of the New Hampshire College, and entomologist of the station. Letters received at the station, and personal interviews with farmers at farmers' institutes and elsewhere, indicate that many of the farmers of the State are reading the bulletins of the station in detail.

NEW MEXICO COLLEGE AND STATION.—A two-story and basement structure of brick and stone, containing fourteen rooms, has just been completed for the use of the college and station. Arrangements have been made to open the mechanical department of the college next September. A large number of trees and vines have been planted on the experimental farm with a view to testing varieties, methods of cultivation, and especially methods of irrigation.

UTAH STATION.—Feeding experiments have been begun with cattle, sheep, hogs, and horses. Among the questions to be studied in these experiments are, the value of native grasses, and the comparative value of silage and dry fodder as feeding stuffs.

VIRGINIA STATION.—The plan of work of the station for 1891 includes co-operative experiments in soil testing, methods of cultivation, testing of varieties of grains and fruits, and the vitality and productiveness of seeds; studies of soils, feeding experiments, and investigations on plant diseases. The special object of the co-operative experiments is to bring the work of the station to the attention of farmers throughout the State.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

FEBRUARY 1 TO MARCH 1, 1891.

DIVISION OF STATISTICS:

Report No. 81 (new series) January and February, 1891.—Report upon the Numbers and Values of Farm Animals, and Freight Rates of Transportation Companies.

BUREAU OF ANIMAL INDUSTRY:

Special Report on Diseases of the Horse, February, 1891.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, Vol. II, No. 7, February, 1891

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

FEBRUARY 1, TO MARCH 1, 1891.

CANEBRAKE AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 10, December, 1890.—Corn; Meteorology; Soil Temperatures.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF CALIFORNIA:
Bulletin No. 90, January 23, 1891.—Fiber Plants for California.

THE DELAWARE COLLEGE AGRICULTURAL EXPERIMENT STATION:
Special Bulletin A, March, 1890.—Fungicides.

GEORGIA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 11, January, 1891.—Fertilizer Experiments; Culture Experiments and Variety Tests in Cotton, Sweet-Potatoes, Field Peas, Garden Vegetables, Etc.

LOUISIANA AGRICULTURAL EXPERIMENT STATIONS:
Third Annual Report, 1890.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:
Meteorological Bulletin No. 25, January, 1891.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:
Bulletin No. 70, January, 1891.—Vegetables, Varieties and Methods of Culture.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF MINNESOTA:
Bulletin No. 13, December, 1890.—A Treatise on Flax Culture.
Bulletin No. 14, January, 1891.—Swine Feeding for Profit; Swine Breeding Sugar-Beets, Their Cultivation, Process of Manufacture, Etc.

NEW JERSEY STATE AND COLLEGE EXPERIMENT STATIONS:
Third Annual Report, 1890.
Bulletin No. 78, January 30, 1891.—Destroy the Black Knot of Plum and Cherry-Trees; An Appeal.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:
Third Annual Report, 1890.
Bulletin No. 25, December, 1890.—Sundry Investigations Made During the Year.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 73*b*, December, 1890.—Meteorological Summary for North Carolina, October and November, 1890; Origin of Cold Waves.

OHIO AGRICULTURAL EXPERIMENT STATION:
Bulletin Vol. III, No. 10 (second series).—Preventing Downy Mildew or Brown Rot of Grapes; The Smut of Indian Corn.

OREGON EXPERIMENT STATION:
Bulletin No. 7, October, 1890.—Comparative Tests of Small Fruits and Vegetables

AGRICULTURAL EXPERIMENT STATION OF UTAH:
First Annual Report, 1890.
Bulletin No. 3, January, 1891.—Experiments with Garden Vegetables.

VIRGINIA AGRICULTURAL AND MECHANICAL COLLEGE EXPERIMENT STATION:
Annual Report, 1890.

DOMINION OF CANADA.

DEPARTMENT OF AGRICULTURE:
Central Experimental Farm, Bulletin No. 8, January, 1891.—Results of Early and Late Seeding of Barley, Oats, and Spring Wheat.

GUELPH AGRICULTURAL COLLEGE:
Bulletin No. 58, February 2, 1891.—Spring Grains in 1890.

EXPERIMENT STATION RECORD.

Vol. 2. APRIL, 1891. No. 9.

EDITORIAL NOTES.

The following brief account of the practical results of recent investigations in the manufacture of sorghum sugar by this Department, has been furnished by Dr. H. W. Wiley, under whose direction they were made. Aside from the great interest which attaches to the results themselves in their application to the sugar industry, these researches serve as another of the already numerous illustrations of the way in which abstract inquiries carried on by purely scientific methods may give results which can be at once applied, to the advantage of practical agriculture. The practical value of the investigations, which now promises to be very great, hinges upon what they have revealed regarding the occurrence and properties of the gummy bodies referred to.

Extensive experiments have been carried on in the Division of Chemistry of the Department of Agriculture during the past eighteen months, looking to the application of alcohol in some practical method for the manufacture of sugar from sorghum.

The basis of this study was found in the well known fact that the gummy and mucilaginous substances which are naturally present in sorghum juices, may be completely separated therefrom by alcohol. Studies were therefore instituted looking to the recovery of the alcohol employed, for the purpose of using it subsequently over and over again. These experiments were completely successful on a laboratory scale.

It was also found that the precipitated gummy and mucilaginous bodies could be easily separated from the sirups in the filter press, forming a hard, firm cake, easily detached from the filter cloths; that the carbohydrate bodies present in the gums and mucilages were completely fermentable, giving a full theoretical yield of alcohol; that in the application of this method the sirups were more easily boiled to grain in the strike pan; and that the sugars produced could be easily dried in the centrifugal.

The flavor of the molasses secured was greatly improved, and this product, therefore, would be rendered more valuable in the market both for direct table consumption and for mixing purposes.

The bodies separated from sorghum sirups by alcohol have also been studied and found to contain a number of new gums and mucilages of interesting chemical composition.

It is believed, from the data obtained in the laboratory, that the yield of sugar from sorghum can be increased fully 33 per cent by the application of this method and that the amount of alcohol wasted in the process will not exceed 5, or at most 10 per cent of the quantity used. If the revenue laws can be so changed as to permit the manufacture of alcohol from the residue of the sorghum factories, it is thought that the alcohol can be produced, ready for use, at an expense of not more than 8 to 10 cents per gallon. If these suppositions are borne out in a practical way, it is seen at once that this method of producing sugar must come into common use and thus help, in a marked degree, to establish the sorghum sugar industry on a firm commercial basis.

The Governor of Alabama recently vetoed a bill, passed by the State legislature, which provided for the distribution of the funds received by the State under the act of Congress of March 2, 1887, among the four experiment stations now in operation in the State. The veto was sustained by the legislature. The grounds of the Governor's action, as stated in his message, are briefly these: (1) The State having assented to the act of Congress and designated the Agricultural and Mechanical College of Alabama as the beneficiary to receive the funds granted by the act, has exhausted its control over the subject. "The beneficiary so appointed by the general assembly then stood in the eye of the law as though it had been solely and exclusively named in the act of Congress itself." (2) "There is an evident purpose in the bill (*i. e.* the act of Congress) to give permanency to the experiment station. * * * If separate stations can be increased at the will of the legislature, the purpose would be measurably defeated." (3) While Congress exhausted the power of selection of the beneficiary of this act after the State once exercised such power, it left the State ample power to direct the colleges or stations receiving the benefits of the act how and where to carry on the experiments. (4) The three stations in Alabama which are not located at the Agricultural and Mechanical College are "branch stations" only in name.

Neither the Canebrake Agricultural Experiment Station nor the others mentioned in the bill, are under the direction or operated in connection with the Agricultural and Mechanical College of Alabama. The Agricultural and Mechanical College of Alabama has nothing whatever to do with their management, or in shaping the experiments or supervising their conduct in any way. They do not even send reports to the college. They are governed by separate and distinct boards, having no legal connection with each other. They are separate and independent in law and in fact. It is true that the director of the experiment station of the college is one of the trustees or governing board of each of the three experiment stations, but he is not even a trustee

in the college. It is also true that the commissioner of agriculture is *virtute officii* a director in the three experiment stations, and is also trustee of the Agricultural and Mechanical College, but this trusteeship is by appointment and not *virtute officii*. The fact that one or more individuals who are trustees or directors of one institution are also directors or trustees in another, does not in any legal sense connect them or make them branches the one of the other.

It also admits of question whether the experiments which the independent experiment stations are required to conduct under the State law, comply with the spirit and scope of the experiments to be conducted at the stations provided for by section 2 of the Hatch act, and the bill under consideration in appropriating the money does not require it to be devoted to such purpose, but simply appropriates a part thereof to each of the experiment stations named therein, to be disposed of necessarily according to the laws under which they are organized.

In corroboration of the views herein expressed, I incorporate the following letter from Hon. Justin S. Morrill to the president of the board of trustees of the Agricultural and Mechanical College, which is as follows:

COMMITTEE ON FINANCE, UNITED STATES SENATE,
January 10, 1891.

DEAR SIR: In reply to your favor of the 6th inst., I am clearly of the opinion that the proposition before your legislature would be considered an evasion of the Hatch act. I should regret to see it passed for the reason that it is somewhat doubtful how long this $15,000 appropriation will be continued, and should it be considered by Congress as having been misapplied, they would suddenly bring such appropriations to an end.

Very truly yours,

JUSTIN S. MORRILL.

Financial statistics of the agricultural experiment stations in the United States as finally computed for the Report of the Secretary of Agriculture for 1890, show the following aggregates: The station revenues for 1890 amounted to $973,146, of which $652,500 was received from the United States; $226,573 from States; $5,500 from local communities; $10,125 from individuals; $38,007 from fees for analyses of fertilizers, etc.; $33,974 from sales of farm produce; and $6,467 from miscellaneous sources. If we add to this the United States appropriation for this Office, $15,000, we have a grand total of $988,146 as the income of the station system in this country last year. This is an increase of about $150,000 over the amount reported for 1889. It is especially encouraging to observe that the appropriations by the several States have materially increased, showing that they appreciate the desirability of co-operating with the General Government in promoting the interests of this great enterprise in behalf of agriculture.

For the fiscal year ending June 30, 1892, Congress has appropriated $728,000, of which $20,000 is for this Office. The appropriation bill for the current fiscal year provided $660,000 for the stations in forty-four States and Territories. In the bill just passed full provision was made for additional stations in Idaho, Wyoming, and Montana, while Oklahoma was given $3,000, the sum requested by her Delegate in the House of Representatives.

The appropriation bill for the United States Department of Agriculture for the fiscal year ending June 30, 1892, carries the following general items: for the Office of the Secretary of Agriculture, $80,500; for investigations regarding the extension of foreign markets for agricultural products, $2,500; Division of Accounts and Disbursements, $19,100; Division of Statistics, $136,100, of which $15,000 is for maps and charts illustrating the progress of rural production and crop distribution, and for special investigations of the agricultural statistics of the Rocky Mountain region; Division of Botany, $48,600; Division of Entomology, $37,300, of which $2,500 is for an investigation of the cotton boll-worm; Division of Economic Ornithology and Mammalogy, $24,860; Division of Pomology, $11,300; Division of Microscopy, $6,700; Division of Vegetable Pathology, $20,600 (investigations of peach yellows, California grape diseases, root rot and blight of cotton, pear blight, and diseases of the orange are especially required); Division of Chemistry, $36,500, of which $12,500 is for the continuance of investigations of the adulteration of food, drugs, and liquors; $50,000 is also appropriated for experiments in the manufacture of sugar, one half of which is for a thorough trial of the method of making sorghum sugar by treating the sirup with alcohol; Division of Forestry, $22,820; Division of Records and Editing, $6,300; Division of Illustrations, $19,000; Division of Seeds, $118,920; $150,000 is also appropriated for the distribution of seeds to drought sufferers in the West; Document and Folding Room, $10,460; Experimental Grounds and Garden, $31,000; Museum, especially for its reorganization, $7,840; fiber investigations, $10,000; Library, $3,000; furniture, repairs, postage, and contingent expenses, $42,000; Bureau of Animal Industry, including $15,000 for quarantine stations, $515,000; Agricultural Experiment Stations, $728,000, including $20,000 for the Office of Experiment Stations; Weather Bureau, $889,753.50; total, $3,028,153.50.

The principal increase in the total sum appropriated this year arises from the transfer of the Weather Bureau from the War Department to the Department of Agriculture, which will be made at the beginning of the next fiscal year.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

Alabama Canebrake Station, Bulletin No. 10, December, 1890 (pp. 13).

EXPERIMENTS WITH CORN, W. H. NEWMAN, M. S. (pp. 3–8).—These were a test of varieties, and experiments with melilotus and peas as soil renovators, with fertilizers, and in pulling fodder and cutting tops.

Test of varieties of corn (pp. 3, 4).—Notes and tabulated record of yields for 12 varieties, 10 white and 2 yellow, on "black slough" bottom-land. The largest yield (42.6 bushels of merchantable corn) was with Madison County Red, a yellow variety. From two years' experience the author believes that "if a better variety of seed was planted in the canebrake the yield would be increased 25 per cent or more."

Melilotus and pea vines as soil renovators (pp. 4, 5).—Melilotus was sown on 1 acre of worn-out land in 1888, and peas on another acre in 1838 and 1889. In December, 1890, the melilotus and peas were plowed under and early in 1890 both acres were planted with corn.

The cost of seeding the acre to melilotus was $3.25, and the cost of seeding to peas was $7 for the two seasons, or $3.50 per season. The melilotus acre produced 40.5 bushels of corn per acre, and the pea vines 51.75 bushels—a difference of 11.5 bushels in favor of the pea vines. Considering the greater cost of seeding the land to peas the difference is very slight. A good crop of hay could have been cut each season and the profits would have been very much increased. From 2 to 4 tons of excellent hay can be cut from an acre in melilotus or pea vines, worth from $18 to $36. The increased yield by leaving the stalks and vines on the land will not pay for the loss of hay. Pea vines will produce better results in one year, for they make more forage the first year and cover the ground better. Melilotus makes a better growth the second year, and after it dies the land is more easily prepared. It is very easily killed by plowing, and is not hard to eradicate either the first year, or after it has re-seeded itself. Before the land was sowed in melilotus and peas it was not considered worth cultivating. This season it produced as fine a crop as the best lands of the station highly fertilized.

Fertilizers for corn (pp. 6, 7).—Three tons of stable manure with 1 ton of green cotton seed, 400 pounds, and 200 pounds of cotton-seed meal per acre were compared with no manure on 4 acres of drained and 4 acres of undrained "black slough" bottom-land.

"Where 400 pounds of cotton-seed meal were applied on drained land the cost of the fertilizer was paid by the increased yield of 10 bushels, at 50 cents per bushel. In all of the other cases there was a decided loss by applying the fertilizers and stable manure. * * * All the experiments [at the station] with commercial fertilizers have given simi-

lar results. Cotton-seed meal always gave the best results, and it was thought that the meal would pay, but the above results seem to prove that it will not." The indications are "that the vegetable sources of nitrogen are the cheapest and best for improving the canebrake lands, and that fall plowing is very beneficial. The frosts, freezes, and winter rains pulverize the soil, and it is in better condition for seed than when plowed in the spring."

Fodder pulling and cutting tops (p. 8).—A number of experiments in fodder pulling and cutting the tops are reported. There was no perceptible increase or decrease in yield where the tops were cut, but there was an increase in yield where no fodder was pulled, averaging about 4 bushels per acre. When labor is hired to pull the fodder there is a loss of $1.50 per acre and often more.

METEOROLOGICAL REPORT (pp. 9–13).—A tabulated monthly summary of meteorological observations from August, 1889, to September, 1890, inclusive; and of soil temperatures at depths of from 1 to 36 inches, from September, 1889, to August, 1890, inclusive. The report on soil temperatures is in continuation of that in Bulletin No. 6, of the station (See Experiment Station Record, Vol. I, p. 188). "The monthly means for the 2 years have varied very little, the drained land averaging a very little higher than the undrained. * * * From the observations it seems as if drainage does not increase the temperature of the soil at any season of the year enough to benefit vegetation." For other reasons, however, the canebrake lands should be thoroughly drained.

California Station, Bulletin No. 90, January 23, 1891 (pp. 4).

THE PRODUCTION OF RAMIE, E. W. HILGARD, PH. D. (pp. 1–3).—This article was written in view of the revival of interest in the culture of ramie in California, growing out of apparently successful trials of a new form of decorticating machine.

> The great beauty of the fiber and the almost unlimited commercial demand for it when brought into the market in available form; its adaptation to a great variety of soils and climates; the high production, the perennial nature of the plant that renders its culture very inexpensive; the possibility of easily maintaining the productiveness of the soil by a return of the trash, placing ramie near to cotton (when the seed is returned), as bearing very lightly on the soil's native fertility; and finally, the relatively high value and light weight of the merchantable product when shipped—all these advantages concur in rendering the culture of this fiber plant especially desirable wherever it is feasible.

The "wet" and "dry" processes for separating and cleaning the fiber are briefly described, and it is stated that the latter—

> Is best adapted to a dry climate, in which the stalks and gummy bark become so brittle that the breaking and beating is effective to a degree which it would be impossible to attain in moist climates like those of Louisiana or Guatemala except by artificial heat, which, as stated, is therefore generally used in connection with the "wet" process. Hence the dry mode of working promises exceptional advantages where, as in the interior of this State, the dryness of the summer air is proverbial.

The dry process also possesses the advantage that each machine can be kept running continuously, on practically uniform material; while in the wet mode of treatment the plants must, in a large field, either be worked at very different degrees of maturity or else the crop must be attacked with a large number of machines, in order to secure uniformity of the product, after which the machines will lie idle. It would therefore seem, on the most general principles, that where the dry process is climatically feasible, it offers advantages over the other method, provided an equally good merchantable product can be turned out. * * *

By actual trial it has been found to be readily feasible to grow ramie in all the larger valley regions of the State, but it will doubtless prove most profitable where a long growing season, combined with irrigation, permits of making three or four cuts annually. In the Kern Valley there is little difficulty in getting four cuts of good size and quality, and the same is probably true on the stronger soils as far north as Fresno and southward in the valley of Southern California. In the Sacramento Valley three cuts can doubtless be obtained, at least when irrigation is employed or in naturally moist land. At Berkeley and elsewhere on the immediate coast two cuts (the second usually a small one) are all that can be counted on; but in warm valleys of the Coast Range doubtless from two to three full crops, according to the supply of moisture and the strength of the soil, may be looked for.

A table shows the yield of white-leaved ramie (*Urtica nivea*) during 4 years (1887-90) on the station grounds at Berkeley. The average yield per acre is estimated to have been about 5,700 pounds of dry stalks for the first cut and 3,300 pounds for the second.

This gross weight of course would be somewhat less in the dry air of the interior of the State, but the figures show that on strong soils the expectation of 18,000 to 20,000 pounds per acre, where four cuts can be made, is not extravagant. The minimum product from dry stalks is estimated to be 15 per cent of raw merchantable fiber. * * *

It is hardly necessary to remind any intelligent farmer that only strong soils can be expected to produce in one season a crop of 10 tons of dry stalks of any kind, and that few can continue to produce such crops for many years without substantial returns to the land, no matter how fertile originally; but there is no reason why the offal of the ramie crop—the leaves and stock trash—should not be regularly returned to the soil. The leaves can be, and usually are, dealt with by stripping the stalk on the ground, leaving them where they grew. As to the stalks, it is true that with three or four cuts per season it will be difficult to deal with the large mass of refuse by spreading it on the stubble, although in the more northerly portions of the area of cultivation it may be desirable to use this material for protection against frost. But as either the return must be made or fertilizers purchased, the proper mode of procedure will be to make compost heaps of the trash, and thus render it less bulky and more convenient for spreading on the stubble after the last cut. This, in the case of strong soils, is all that will be required to keep up production for a long time, although the raw fiber sold represents a larger proportion of the soil's plant food than in the case of cotton, in which the return of seed and stalk will maintain production indefinitely on any soil capable of yielding a profitable crop. When no returns are made ramie will prove even a more exhaustive crop than cotton when the seed is not returned, and those engaging in its culture had better understand from the outset that they can "rob the soil" with ramie even more effectually than with wheat.

Among the strongest soils in the State are those containing more or less of "alkali," and as these are mostly valley lands, the question of their adaptation to ramie culture is important. Experiments have shown that while ramie is a little more sensitive to alkali than alfalfa, it will stand all but the strongest spots provided the alkali is not of the "black" kind, viz., carbonate of soda; and as the conversion of black alkali into "white" is easily effected by the use of proper doses of plaster or gypsum, it may fairly be said that with this proviso ramie may be grown in alkali lands avail-

able for little else, since the growing of alfalfa can not be carried beyond a limited point with profit to the producer on account of its relatively low value and heavy weight in transportation. The main reason why ramie will grow in alkali ground is the same as in the case of alfalfa—because it shades the ground, and hence the evaporation, going on through the leaves of the plants instead of at the surface of the soil, will not accumulate the noxious salts around the root crowns so as to corrode them. But it must not be forgotten that until the plants fully shade the ground the rise of alkali in the "middles" must be prevented by thorough tillage, otherwise damage may result in that the outermost shoots suffer and the spread of the plants is retarded. As against alfalfa, ramie also possesses the advantage that as it is not propagated from seed (in the field at least), but by the division and setting out of plants or their roots, the difficulty of obtaining a stand on account of the rotting of the seed by the alkali does not exist.

So far, then, as the successful and profitable growth of the plant in the valleys of the central and southern parts of the State is concerned, there need be little doubt, so soon as the processes for marketing the fiber shall be an assured success.

[For further statements regarding the production and manufacture of ramie, see A Report on Flax, Hemp, Ramie, and Jute, 1890, Division of Statistics, United States Department of Agriculture, referred to in Experiment Station Record, Vol. I, p. 299.]

FLAX FOR SEED AND FIBER, E. J. WICKSON, M. A. (pp. 3, 4).—A brief account of experiments with varieties of fiber flax introduced from Europe by the station, as compared with a variety grown from California seed. The European varieties are Russian, Royal, Yellow-Seeded, and White-Flowered. These produced less seed but more and better fiber than the California variety. The Russian and Royal seemed to be the best of the European varieties for both seed and fiber.

The natural color of the straw [of the flax grown at the station] was very light; that of the fiber, almost perfectly white in each sample. The total yield of the fiber, 23 per cent of the weight of the straw, was rather a light yield of fiber, but very fine. The yield of fiber is greater when the straw is not overripe. The samples treated had been allowed to get riper than required for either seed or fiber.

The results of this trial are of interest, as showing clearly the superiority, from a textile point of view, of the flax varieties which this station has introduced to this coast over the common variety which is grown for seed. Whether it is possible to realize more by the attempt to produce both seed and fiber here, and to substitute one of these varieties for the one commonly grown, is an industrial question depending upon manufacturers and capitalists for solution. The farmer can not afford to produce a crop of any kind until a market is assured.

Connecticut State Station, Annual Report, 1889 (pp. 280).

REPORT OF DIRECTOR, S. W. JOHNSON, M. A. (pp. 7, 8).—A brief outline of the work of the station in 1889.

THE EFFECT OF THE RATE OR DISTANCE OF PLANTING ON THE QUANTITY AND QUALITY OF THE MAIZE CROP.

Experiment of 1888 (pp. 9–48).—This is an experiment made under the supervision of the station on the land of a farmer of the State. An acre and a half of meadow land, which had been in grass for 5 years, was divided into three strips, each about 408 feet long by 68 feet wide, with a 4-foot space between. On two adjacent strips an ammoniated superphosphate,

containing 4 per cent of nitrogen, 7 per cent of potash, and 9.8 per cent of phosphoric acid, was sown broadcast at the rate of 1,000 pounds per acre; and on the third strip the same fertilizer at the rate of 2,000 pounds per acre. Each strip was then subdivided into six plats of nearly one tenth acre each, with 4-foot spaces between them, making in all eighteen plats. White Edge dent corn was planted on eleven plats, and Rhode Island White Cap, a small flint variety, on the remaining seven plats. On the three plats running across the southern end of the strips one stalk was left standing to every 4 feet in the rows (rows 4 feet apart); on the next three, one stalk to every 2 feet; and one stalk, two stalks, four stalks, and eight stalks to a foot on the remaining four rows of plats, respectively. The crop was cut, sampled, harvested, and weighed, plat by plat. The tabulated data include the gross weights of the field-cured crops from each plat; weight of dry matter in the same; total amounts and percentages of the different parts of the plant; the percentage composition of the field-cured crops of the several parts of the plant, and of the dry matter in the field-cured crops; total amount of each food ingredient produced on each plat; weight of the water-free product and of the ash, albuminoids, fat, etc., in one hundred plants grown at each of the distances named; pounds of nitrogen, phosphoric acid, and potash contained in the crops per acre; yield of water-free ears and stover of the dent and of the flint corn; yield of the dent and flint corn per acre; and the composition of the water-free crop and of the sound kernels of dent and flint corn.

The following points were brought out by the experiment:

(1) Maize of the flint variety produced most dry matter when the plants stood a foot apart in the row. Thicker planting, as well as thinner planting, decreased the yield.

(2) The dent variety produced most dry matter when the plants stood two to a foot in the row. Thicker planting than this decreased the yield of dry matter. The increased weight of gross yield noticed above with the thicker stand was wholly made up of water.

(3) The extra phosphate also increased in every case the dry weight of the crop.

Weights of the separate parts of the water-free maize plant in the total crops.—(1) [With the flint variety] the yield of sound kernels, or dry shelled corn, increased steadily with the thickness of planting up to a stand of two plants to the foot. The yield fell off rapidly when that limit was passed and eight plants to a foot produced no sound kernels at all. The highest yield of dry matter was from planting a foot apart. But a thicker planting in this case yielded more sound kernels. Extra phosphate produced some sound ears with the thickest planting.

(2) The yield of soft kernels followed the opposite course. It was smallest where the yield of sound kernels was largest and increased as the sound kernels decreased.

(3) The dry weight of leaves increased regularly with the thickness of planting and was greatest where the stand was thickest. The extra phosphate decreased the yield.

(4) The dry weight of stripped stalks increased with the thickness of planting up to a stand of one plant to a foot—a distance which gave the largest yield of dry matter and then fell off with thicker planting, though the very closest planting gave nearly as large a yield of dry canes as any other, and the extra phosphate nearly doubled this yield.

(5) The yield of husks increased and decreased with the yield of sound and soft kernels, as was to be expected.

(6) The yield of cobs showed irregularities which create suspicion of errors in weighing.

(7) The dent variety showed nearly the same course as the flint variety in the increase and decrease of sound and soft kernels and leaves, due to rate of planting, but there was a striking difference in the water-free weight of stripped stalks. While the weight of water-free stalks of the flint variety was greatest where the plants stood one to a foot in the row, the weight of water-free stalks of the dent variety increased steadily with the thickness of stand, and was greatest where the stand was thickest—eight plants to a foot.

Proportions of kernels, leaves, stalks, etc., in the water-free crop.—(1) The proportion of sound kernels of the flint variety to total water-free crop increased with thickness of planting up to a stand of two stalks to a foot, and then, with closer planting, decreased rapidly, while the proportion of kernels of the dent variety to total crop was greatest when the stand was one stalk to 2 feet, and the proportion decreased with thicker planting. The extra phosphate increased the proportion of sound kernels of flint maize, but rather decreased it in the case of the dent variety.

(2) The proportion of leaves to total dry crop was largest where the proportion of sound kernels was smallest. The extra phosphate decreased the proportion of dry weight of leaves of the flint variety, but increased the proportion of leaves of the dent variety.

(3) The proportional yield of stripped stalks showed some irregularities, but in each variety the relative yield of canes was largest where the stand of maize was thickest. The proportion of dry weight of stalks of the dent variety increased regularly from the plat where the stand was one stalk to 2 feet up to the thickest stand. It was not materially changed by the addition of extra phosphate.

Percentage composition of the dry matter in the field-cured crops.—The per cent of ash and albuminoids in the water-free crop was greatest where the stand of maize was thinnest and decreased regularly as the stand was thicker, being least where the plants stood closest. This difference was quite small in the case of ash, but very large in the case of albuminoids.

The per cent of fiber was largest where the stand was thickest and probably decreased pretty regularly as the stand of maize was thinned. There was the largest percentage of nitrogen-free extract where the stand of maize was neither very close nor very thin, but from two to four stalks to a foot.

Total quantities of water, ash, albuminoids, etc., harvested from each plat.—A study of the results with the *flint* variety shows:

(1) The quantity of ash, of albuminoids, of fiber, of nitrogen-free extract, and of fat, every valuable ingredient in the crop, was largest when the plants stood one to a foot.

(2) A stand of two to a foot produced very little more of any ingredient than a stand of one to 2 feet. The single exception to this is nitrogen-free extract. * * *

Examining the results with the *dent* variety of maize, it appears:

(3) The quantity of ash or mineral matter, of albuminoids, of nitrogen-free extract and of fat was largest when the plants stood two to a foot, but the largest quantity of fiber was produced by the thickest planting, eight plants to a foot.

(4) A stand of one plant to a foot produced more of every ingredient except fiber than a stand of four to a foot, so the rate which would have given the maximum yield was either two to a foot or between one and two to a foot.

(5) In every case the extra phosphate produced an increase of all the ingredients of the crop.

Comparative development of the individual maize plant.—Examination of the figures shows that the individual plants which stood farthest apart, and had the most light and the most soil at their disposal attained the greatest development in all their

parts. It also shows that the yield per plant quite regularly decreased as the stand became thicker, though not by any means proportionally to the closeness of the stand. * * * It would seem as if the smaller flint maize ought to attain its maximum development with a smaller area of soil, *i. e.* with closer planting than the dent variety, but this has not been the case in this experiment. * * * [A table which gives the quantities of essential ingredients contained in 1,000 plants from the different plats], shows that not only the total dry weight per plant regularly increases with increased distance of planting, but that the weight of each food ingredient in it increased at a similar rate. It is a striking fact that the percentage of albuminoids in the dry matter from the individual maize plant regularly increased as the stand of plants was thinner. * * *

The effect of rate of planting as modified by manuring.—The extra phosphate on each plat, without exception, not only increased the total yield over the corresponding plat which had half the quantity of phosphate, but also increased the yield of each food ingredient of the crop. It also slightly increased the percentage of albuminoids in the water-free crop. It also increased the development of the individual corn plant. We have no accurate data for calculating the money gain or loss caused by applying the extra phosphate. * * *

Comparison of the flint and dent varieties of maize.—The total water-free crop of dent maize was largest and the total quantity of each food ingredient except fiber was greatest on the plat where the rate of planting was two stalks to a foot in the row. * * *

[With the flint variety] the total weight of ears was largest where the rate of planting was one stalk to a foot; the most sound kernels were harvested from thicker planting.

The largest quantities of each food ingredient in the flint maize were also harvested from the plat where the stalks stood one to a foot, while in case of the dent variety, two stalks to a foot gave the largest yield of these ingredients.

The dent variety yielded 20 per cent, or one fifth more of water-free crop than the flint.

The yield of sound shelled corn and of total shelled corn of the dent was only slightly larger than of the flint.

The increased yield of crop in the case of the dent variety was large in leaves, but chiefly in stripped stalks.

Regarding next the chemical composition of the water-free crop, it appears that the chief differences between the two varieties are in the percentages of albuminoids and fiber. The water-free crop of the dent variety has in round numbers 2.75 per cent more fiber and 1.75 per cent less albuminoids than the flint variety, and is, in so far, pound for pound, less valuable as cattle food.

The dent variety yields very considerably more per acre of fiber and of nitrogen-free extract and somewhat more fat. The flint variety yields considerably more ash and about the same quantity of albuminoids as the dent.

Remarks are made on the raising of corn for seed and for silage purposes, and a brief statement is given of the general facts regarding the effects of rate of planting on quantity and quality as observed by other experimenters, the statement being taken in substance from Dr. Ewald Wollny's Planting and Cultivation of Farm Crops.

Experiment of 1889 (pp. 219-231).—The experiment of 1889 was similar to that of 1888 and was made on the same field. The kinds and quantities of fertilizers, and the distance of planting were the same as in 1888, but there were only six plats and they were all planted to White Edge dent corn. "The experiment in its main features is a confirmation of the previous experiment." The effect of distance of planting on

the gross yield and the yield of dry matter; on the percentage of kernels, cobs, and stover in the dry matter; on the comparative development of the individual maize plants; and on the percentage composition of the dry matter in the field-cured crop, except with regard to the nitrogen-free extract, was the same as in 1888. In 1889 the percentage of nitrogen-free extract "was largest where the stand was one stalk to a foot, but not very different in the two plats on which the stand was thinner." In 1888 "two stalks to a foot produced the largest percentage with rapid decrease where the stand was thinner." With the dent variety the largest quantities of albuminoids, of fat, and of nitrogen-free extract were produced in 1888 where the plants stood two to a foot, and in 1889 where they stood one to a foot.

In the two years the actual yields of plats C and D [one stalk to a foot, and two stalks to a foot] were 141 bushels of [dent] shelled corn per acre, and the stover and shelled corn together took from an acre of land in these two crops the quantities of nitrogen, phosphoric acid, and potash given below. There are also given the quantities of the same ingredients which were put on in the fertilizer during the two years.

	Nitrogen.	Phosphoric acid.	Potash.
Put on per acre in fertilizer during 2 years	90.5	211.4	155.6
Taken off in crop during 2 years	155.7	68.1	98.6
Gain +, loss -, to the land	—65.5	+146.3	+57.0

It appears that the soil has been drawn upon for 65 pounds of nitrogen—four fifths as much as is required for a full crop of corn. At the same time it has been enriched by as much phosphoric acid as four crops would take from it and by as much potash as a single crop requires.

This is the result of using a fertilizer containing 4.5 per cent of nitrogen, 10.7 of phosphoric acid, and 7.8 per cent of potash at the rate of 1,000 pounds per acre, without stable manure.

Evaporation of water during field curing.—"The total weight of crop at the time of cutting was 15,114 pounds per acre, and at harvest 9,156 pounds per acre. If now we assume that there was no loss of dry substance by fermentation or otherwise during the curing, the difference, 5,958 pounds, is the water which evaporated during field curing—nearly 3 tons per acre."

Analyses of the dry matter of the crop at the time of cutting, when field cured and when house cured, indicated that "the crop did not suffer any great loss from fermentation during field curing."

Comparison of the crops of 1888 *and* 1889.—A table which gives the weight of water contained in the field-cured crops for each distance of planting, calculated to like amounts of dry matter, "shows that with the same yield of dry matter in the 2 years there would have been from 662 pounds to 4,281 pounds more of water to be handled in 1888 than in 1889, or with the average rate of planting, one to two stalks to a foot in the row, about 1.75 tons more of water per acre in 1888 than in 1889.

* * * The crops on all the plats, and the yield of each food ingred-

ient, as well as [the percentage of albuminoids in the crops in particular], were very considerably smaller in 1889 than in 1888."

FERTILIZERS (pp. 49–126).—This contains the text of the Connecticut fertilizer law; a list of the dealers who have complied with the requirements of the law during the year; trade values of fertilizing ingredients for 1889; remarks on the valuation of superphosphates, special manures, and mixed fertilizers; popular explanation of "the analysis of fertilizers and the valuation of their active ingredients;" remarks on home mixing; and analyses of 242 samples of fertilizing materials, including nitrate of soda, sulphate of ammonia, dried blood, cotton seed meal, castor pomace, horn shavings, bone-black, sulphate of potash, double sulphate of potash and magnesia, muriate of potash, kainit, sylvanit, ground bone, tankage, barn-yard manure, plaster, mussels, salt marsh mud, muck, wool waste, tobacco stems, wood ashes, cotton-hull ashes, nitrogenous superphosphates, guanos, and home-mixed fertilizers. There is also a review of the fertilizer market for the 13 months ending January 1, 1890, and a tabulated comparison of the prices of nitrogen, potash, and phosphoric acid from different sources for each of the last 6 months of 1886, and for each month during 1887, 1888, and 1889.

In 1889 the average selling price of ammoniated superphosphates and guanos was $34.10, the average valuation was $29.10, and the difference $5—an advance of 17.2 per cent on the valuation and on the wholesale cost of fertilizing elements in the raw materials. In case of special manures the average cost was $40.25, the average valuation $35.20, and the difference $5.05, or 14.3 per cent advance on the valuation.

REPORT OF MYCOLOGIST, R. THAXTER, PH. D. (pp. 127–177).—This includes an introduction in which a popular explanation of fungous diseases is given; notes on certain fungous diseases of the onion, mildew of Lima beans, and several other plant diseases more or less prevalent in Connecticut in 1889; and a report on experiments with the Bordeaux mixture as a fungicide. The report is illustrated with one plate showing the results of plat experiments in the treatment of onion smuts; and two plates, containing forty-six figures, illustrating thirteen fungous diseases of different plants.

Certain fungous diseases of the onion (pp. 129–167).—This is a preliminary report on one year's investigation of the fungous diseases of the onion. Especial attention was given to the so called smut of onions (*Urocystis cepulæ*, Frost). The topics under which this disease is discussed are history, origin, general characters, distribution and severity, conditions influencing its prevalence and increase, dissemination, retention of germinative power by spores, botanical history and relations, manner of infection, experiments by the station for its prevention, and general precautions.

Notes are also given on the onion mildew (*Peronospora schleideniana*, Ung.), onion macrosporium (*Macrosporium sarcinula*, Berk., var. *parasiticum*, Thüm.), larger onion macrosporium (*Macrosporium porri*, Ell.), onion vermicularia (*Vermicularia circinans*, Berk.), together with a list of fungi parasitic on members of the genus *Allium*.

Mildew of Lima beans (pp. 167–171).—A description of the fungus causing a disease of the Lima bean at New Haven, Connecticut, and vicinity, from observations by the author. This disease is denominated mildew of Lima beans (*Phytophthora phaseoli*, Thaxter). The potato blight (*Phytophthora infestans*), and a disease prevalent in Europe on many coniferæ, several varieties of cacti, and other plants (*Phytophthora cactorum*) are the only other known species of this genus.

Miscellaneous notes (pp. 171–174).—Brief notes on the following diseases: white blast of Indian corn (*Helminthosporium inconspicuum*, C. & Ell.), smut of Indian corn (*Ustilago maydis*, D. C., *Monilia fructigena*, Pers.), anthracnose of raspberry (*Glœosporium necator*, E. & E.), blackberry rust (*Cæoma nitens*, Schw.), *Cladosporium fulvum*, Cke., *Phytophthora infestans*, Mont., *Cercosporella persica*, Sacc., pear scab (*Fusicladium pyrinum*, Lib.), "spot" of quinces (*Entomosporium maculatum*, Lev.), strawberry blight (*Sphærella fragariæ*, Tul.), anthracnose of grapes (*Sphaceloma ampelinum*, De B.), *Puccinia coronata* and *P. graminis*, and *Uromyces striatus*, Schröt.

Experiments with Bordeaux mixture (pp. 174–177).—The Bordeaux mixture was successfully applied for black rot in a vineyard of Concord grapes at Meriden, Connecticut. The untreated rows failed to produce any grapes, while the treated rows yielded a crop of from 60 to 75 per cent in good condition. The mixture was also applied to two large trees of Lombard plums for the fruit monilia (*Monilia fructigena*), black knot (*Plowrightia morbosa*), and plum-leaf fungus (*Septoria cerasina*). "The two treated trees held their foliage intact up to severe frost in October, showed hardly any black knot, and matured a fair amount of fruit; while an untreated tree near by was defoliated in August, matured no fruit, and was badly infested by the black knot." An application of the Bordeaux mixture at Hamden, Connecticut, to potato vines attacked by the blight resulted in the partial preservation of the foliage, but for some unexplained reason the crop of potatoes from the treated rows did not weigh as much proportionally as that from the untreated rows.

NOTES IN ANSWER TO INQUIRIES CONCERNING INJURIOUS INSECTS (pp. 178–180).—Brief notes on *Mamestra picta*, *Telea polyphemus*, *Citheronia regalis*, *Phlegethontius carolina*, *Cœlodasys unicornis*, *Ecpantheria scribonia*, *Crioceris asparagi*, *Coleothrips 3-fasciata*, and *Thrips* n. s. (causing "white blast" of onions).

LABORATORY APPARATUS (pp. 181–202).—This includes illustrated descriptions of the following pieces of apparatus "devised at this station and proved by lengthened service to be satisfactory:" hydrogen generator made by S. W. Johnson and T. B. Osborne, supplying a larger quantity of gas and under a greater pressure than the ordinary Kipp generator; a gas desiccator designed by S. W. Johnson, primarily for drying the hydrogen used in moisture determinations of certain vegetable products; an apparatus for drying in hydrogen, and an aliquotimeter, devised by A. L. Winton, the latter to assist in the routine work

of fertilizer analysis; apparatus for determining nitrogen according to the Kjeldahl method; an oven for drying large samples of grasses, forage plants, etc.; and a modification of the Schulze Tiemann apparatus for determining nitric acid, devised by T. B. Osborne.

The station uses an Otto gas engine of one and one quarter horse power for running the mill used for grinding samples of feeding stuffs for analysis, and has found it very satisfactory.

COMPARATIVE AGRICULTURAL VALUE OF SUPERPHOSPHATES AND CERTAIN NATURAL OR RAW PHOSPHATES (pp. 203–219).

For the last 3 years the station, with the co-operation of farmers in different parts of the State, has carried out field experiments designed to give information on this subject. Facts which suggested the experiments may here be again briefly stated.

The market price of phosphoric acid varies greatly according to the form in which it is bought. Thus, it costs in dissolved bone-black about 8 cents per pound; in dissolved South Carolina rock, between 5 and 6 cents; in Bolivian guano, between 4 and 5 cents; and in Grand Cayman's phosphate and ground South Carolina rock, 3 cents a pound.

That the more expensive forms are also the ones most quickly available to plants may readily be admitted, but it is a question whether the cost prices stand always in direct relation to the agricultural value; that is, on land deficient in phosphates will $5 per acre spent in buying dissolved bone-black, for instance, yield a greater or less return in the long run than the same money spent for South Carolina rock or other raw phosphates, seeing that more than twice as much phosphoric acid can be bought for the same money in some of the cheaper forms, as can be bought in dissolved bone-black? The fact that the farmers of this State spend annually from $275,000 to $300,000 for phosphoric acid alone, makes this question practical and important. * * *

The general plan of these experiments has been to broadcast over the whole field under experiment a liberal quantity of nitrogenous matter and potash salts, and to divide it then into seven or more plats of equal size. On one plat a quantity of dissolved bone-black was used, which, it was believed, would not be in excess of the needs of a full crop, but rather slightly deficient. Two other plats, with no phosphates, served to show what the land could produce without the addition of phosphates. On single plats each of the other phosphates was used in such quantity that the cost of each was just equal to the cost of the dissolved bone-black on the first plat. The comparative effects were measured by the weights of the crop produced.

The results of experiments on three different farms are given. Owing to the unevenness of the land used in one experiment "the results there are of little use." Of the two remaining one was commenced in 1887, the other in 1888. The first was on seven eighth-acre plats. In 1887 dissolved bone-black 32 pounds, finely pulverized Grand Cayman's Island phosphate 56 pounds, Thomas slag 67.5 pounds, ground South Carolina rock 70 pounds, and gypsum 16.9 pounds, were each applied on one plat, and two plats received no phosphate or gypsum. All of the plats received muriate of potash at the rate of 200 pounds per acre, and sulphate of ammonia at the rate of 100 pounds per acre. As the object was to observe the after effects of the different phosphates, no phosphates were applied in 1888 and 1889; but muriate of potash, 320 pounds per acre each year, and sulphate of ammonia, 160

pounds per acre, in 1888, and 100 pounds, in 1889, were applied on all the plats. The same variety of corn was raised on all the plats in the three successive years. The results for each year were as follows:

In 1887, the year in which the phosphates were applied, equal money values of dissolved bone-black, Grand Cayman's phosphate, and Thomas slag had approximately equal effects on the yield of the corn crop. An equal money value of ground South Carolina rock produced less than half as much increase of sound ears as the other phosphates and no increase at all of stover. * * *

In 1888 no phosphates were applied. The effects of Grand Cayman's phosphate and Thomas slag, however, were as pronounced as they were the year before, making as large or a larger percentage increase over the plats which had received no phosphate in 1887. South Carolina rock made a considerably larger percentage increase than the year before, showing that it was slowly becoming available in the soil. But while Grand Cayman's phosphate and Thomas slag produced nearly 40 per cent more of sound ears and 25 per cent more of total crop than the no-phosphate plats, dissolved bone-black yielded only 11 per cent more of sound ears and 6 per cent more of total crop than the no-phosphate plats * * *

The yield of corn in 1889 was very small, as was anticipated. The stover was so damaged by continuous wet weather and blight that it was not thought worth while to weigh it. We have, therefore, only the weights of the ears for comparison. From these it appears that the plat which had received dissolved bone-black in 1887 produced no more ears than the plats which received no phosphate then or since. This fertilizer had entirely spent itself in the two previous years. Grand Cayman's phosphate and Thomas slag, however, produced 45 and 56 per cent more corn than the no-phosphate plats, and South Carolina rock 29 per cent, a larger percentage increase, indeed, than either last year or the year before.

That is, to carry out the illustration the investments made in Thomas slag, Grand Cayman's phosphate, and South Carolina rock in 1887 were still paying considerable dividends in 1889, while the investment in dissolved bone-black had ceased to yield any returns whatever.

On this particular piece of land and in these three seasons Thomas slag and Grand Cayman's phosphate have been more profitable than dissolved bone-black.

The other experiment which was commenced in 1888 was on sixteenth-acre plats. Dissolved bone-black 16 and 32 pounds, Grand Cayman's phosphate 23 pounds, Thomas slag 27.5 pounds, South Carolina rock 34.5 pounds, and Bolivian guano 27.5 pounds, were each applied in 1888 on one plat, and two plats received no phosphate. No phosphates were applied in 1889. On all the plats muriate of potash at the rate of 320 pounds per acre, and sulphate of ammonia 200 pounds per acre, were applied each year. Corn was raised both years. The results were as follows:

In 1888 dissolved bone-black gave a much heavier yield than an equal money value of any other phosphate. This year [1889] it has yielded much less, both of ears and stover, than any other phosphate. * * * The double quantity of dissolved bone-black applied last year has produced about as large a relative gain this year as last. * * *

The most striking thing in the experiment of 1889 is the very large increase produced on the Bolivian-guano plat over the yield of the no-phosphate plats, which is particularly noticeable in the ears. Whether this is due to the rapid disintegration and solution of the phosphate by a single season's exposure, or to an effect on the soil produced by the large quantity of carbonate of lime contained in it, must be left undecided for the present.

The results of these experiments and those of Mr. Bartholomew agree in this, that the larger part of the dissolved bone-black has been used up in a single year, and that in the second year after application, Thomas slag, Grand Cayman's phosphate, and even South Carolina rock (Bolivian guano was not included in Mr. Bartholomew's tests) have given considerably larger yields than dissolved bone-black.

The results differ from Mr. Bartholomew's in this: first, that in the first year dissolved bone-black gave a much larger yield than any other phosphate; and secondly, in consequence largely of the very small total crops in 1889, dissolved bone-black paid much better than any other phosphate, taking the two years together.

The last described experiment was repeated in 1889 on the same farm. The land used had been fertilized the previous year with Mapes's potato manure. Part of it had been planted to potatoes and the remainder to buckwheat. In 1889 dissolved bone-black 160 pounds, Grand Cayman's phosphate 23 pounds, Thomas slag 27.5 pounds, ground South Carolina rock 34.5 pounds, Bolivian guano 27.5 pounds, and Mona Island phosphate 23 pounds were each applied on one (sixteenth-acre) plat; and two plats received no phosphate.

Corn was planted on all the plats, the yields of which are tabulated. The results indicate a "lack of uniformity in the soil."

The dissolved-bone black plat was the only one which produced more sound ears than soft ears.

The dissolved bone-black plat yielded four times as much ears and twice as much stover as the no-phosphate plats, one and three fourths times as much ears as Thomas slag or Grand Cayman's phosphate, and nearly twice as much as South Carolina rock. Bolivian guano and Mona Island phosphate made little increase of crop.

In a one-year experiment with potatoes on another farm, in which the effect of the above-mentioned phosphates was tested, the land proved to be uneven in fertility, so that "a close comparison of the crops can not properly be attempted. All the phosphatic applications evidently had some good effect, but the highest yield was from Thomas slag, which in this experiment appears to have been almost as readily available a source of phosphoric acid as dissolved bone-black itself."

Two one year experiments to test the effects of the different phosphates on corn, were made on different fields about 2 miles apart. Three hundred and twenty pounds of muriate of potash and 200 pounds of sulphate of ammonia per acre were used on all the plats, and each of the phosphates was applied to one-twentieth-acre plat. One field "showed no marked effect from any phosphate, and therefore received no further notice." The results on the other fields are tabulated.

(1) Bolivian guano and South Carolina rock have produced absolutely no increase, either in ears or stover, over the no phosphate plats.

(2) Dissolved bone-black has produced the highest yield—more than 50 per cent larger than where no phosphate was applied.

(3) Mona Island guano ranks next to dissolved bone-black, while Thomas slag and Grand Cayman's phosphate rank nearly alike and gave not quite half as large an increase over the yield of the no-phosphate plats as dissolved bone-black gave.

EASTERN AND WESTERN SWEET-CORN FOR SEED (p. 232).—Notes on Evergreen and Early Crosby sweet corn grown at the station from

seed from Michigan, Connecticut, Nebraska, and Ohio, together with the composition of the dry matter of the kernels of each sample.

FORAGE PLANTS OF THE SALT MARSHES OF CONNECTICUT, A. L. WINTON, JR., PH. B. (pp. 233-245).—"In 1884 the United States Department of Agriculture published a report on the tide marshes of the United States,* from which it appears that there are in Connecticut 34.79 square miles or 22,264 acres of 'salt marsh,' and 1.67 square miles, or 1,069 acres of 'swamp land' or fresh-water tide marsh. * * *

"It appears that of the 23,300 acres of marsh, both salt and brackish, 5,369 or nearly one fourth lie about New Haven.

"The money value of the salt marshes in this State ranges from less than $10 per acre upwards, according to the character of the land and its situation.

"With the exception of a few acres of reclaimed marsh the only crop gathered from this large area is the so-called 'salt hay,' which varies greatly from place to place in the character of the herbage producing it, yields from one half two to or more tons per acre, and brings in market not more than from one half to three fourths as much per ton as upland hay. The marshes are neither manured nor tilled in any way by their owners. * * * The sediment which settles from the water that overflows them during high tides, or in the case of the river marshes during freshets, supplies the only fertilizer which they get, and is a kind of natural sewage irrigation. The importance of ditching is well understood."

Cutting and curing the hay.—The meadows are mowed anywhere from the middle of June to December. Although "black grass," "three-square," and most of the other marsh plants, excepting, perhaps, "red salt grass," yield a larger and better crop of hay the latter part of June or the first part of July than afterwards, still, as a matter of fact, few farmers cut salt hay till much later in the season. When the marshes are firm enough to bear it the grass is cut with mowing machines The horses' feet are often shod with "clods," which are stout pieces of board 7 by 9 inches square, attached to their hoofs by means of irons fastened with bolts. * * * The value of the hay for feeding varies greatly, according to the kinds of plants which compose it, as well as the time when cut. We have seen well-conditioned stock that have received none other than good salt marsh hay, while on the other hand some hay cut on the marshes is entirely unfit for feeding. The coarser kinds are only useful for litter, and on some farms salt hay is used exclusively for this purpose. The hay from "red salt grass" makes an excellent mulch, which is particularly valued by strawberry growers, being quite free from any seeds which can prove troublesome. Salt hay is also largely used for packing crockery, etc.

Brief descriptions are given of the following kinds of plants growing on the salt and brackish marshes in the State, together with tabulated results of analyses of most of these plants: black grass (*Juncus gerardi*), salt grass (*Spartina juncea*), creek sedge (*Spartina stricta*, var. *glabra*), spike grass (*Distichlis maritima*, or *Brizopyrum spicatum*), sea club rush (*Scirpus maritimus*), goosegrass or greasy bog (*Triglochin maritimum*),

* Miscellaneous Special Report No. 7, The Tide Marshes of the United States, by D. M. Nesbit, with contributions by the U. S. Coast and Geodetic Survey.

three square (*Scirpus pungens*), larger three-square (*Scirpus olneyi*), florin (*Agrostis alba*), cord grass (*Spartina cynosuroides*), snip-snap or two-tail (*Eleocharis rostellata*), wild rice (*Zizania aquatica*), wild rye grass (*Elymus virginicus*), cat's-tail (*Typha latifolia*).

It appears from the tables of analyses that in every case any given species contains a higher percentage of albuminoids, the most costly food ingredient, and generally also of fat, which is next in value, when cut before or at the time of bloom, than when it is cut at a later period of development. The same is known to be true of the grasses on upland meadows, and the fact harmonizes with the belief of some farmers that hay should be cut at the time of bloom on salt marshes as well as on upland. * * *

The following statement shows the average percentage composition of mixed timothy and redtop and mixed meadow-grasses, black grass cut when seed was in the milk or before, salt grass, and creek sedge, all reduced to a water free basis:

	Timothy and redtop.	Mixed meadow-grasses.	Black grass (*Juncus gerardi*).	Red salt grass (*Spartina juncea*).	Creek sedge (*Spartina stricta*).
Ash	5.5	5.5	7.9	9.3	11.7
Albuminoids	7.4	7.6	9.2	6.0	7.2
Fiber	34.4	35.6	29.0	28.6	29.4
Nitrogen-free extract	50.4	48.9	51.3	53.4	49.5
Fat	2.3	2.4	2.6	2.7	2.2
Total	100	100	100	100	100

These figures show that when cut in proper season creek sedge has practically the same percentage of albuminoids and fat as good meadow hay, with less fiber or woody tissue. Black grass may have 1.75 per cent more albuminoids, a little more fat, and considerably less woody fiber than these meadow-grasses. Black grass in blossom is quite as soft and fine as the best meadow hay and has a pleasant odor and flavor. * * * Another point to be noted is this, that all the marsh grasses which are used for feed or litter bring no inconsiderable quantities of plant food from the rivers and sea to the manure heaps. * * * Taking the average of determinations made, we find the following quantities, in pounds, of nitrogen, phosphoric acid, and potash in a ton of hay of the kinds named, respectively:

	Black grass.	Salt grass.	Three-square.	Creek sedge.
Nitrogen	23.8	17.4	23.8	21.8
Phosphoric acid	5.0	5.4	5.0	7.4
Potash	42.0	14.0	30.2	21.2

Five tons of this hay contains as much of these fertilizing materials as are contained in a full crop of corn, including stover, from an acre of land.

COMPARISON OF THE YIELD AND COMPOSITION OF CERTAIN GRASSES IN 1888 AND 1889, E. H. JENKINS, PH. D. (pp. 246, 247).—"In the Annual Report of the station for 1888, p. 100, are described in detail certain plats of grass, each containing only a single species, from which the crops are to be annually gathered (each at the period of full bloom), weighed, and analyzed. The weights and analyses of the crops for 1888 are also given in the report for that year."

The experiments were continued in 1889, and the results of the analyses of nine species of grasses are tabulated in this article.

The leading facts which appear from a comparison of the crops of 1888 and 1889 are these:

(1) The weight of the water-free crops on three plats was less in 1889 than in 1888, but on the other six plats it was larger, and the gross yield from them all was 7 per cent larger in 1889 than in 1888.

(2) In the water-free crops the percentage of ash did not exhibit very striking differences in the two years. The per cent of fiber and of nitrogen-free extract was on the average considerably larger in 1889 than in 1888. The percentage of fat was smaller. In 1889 there was on the average in the dry matter of these grasses 28 per cent less albuminoids than in 1888. The minimum difference was 16 per cent, the maximum difference 40 per cent.

A similar though not so striking difference in the percentage of albuminoids has already been noticed in the corn crops of the two years.

ON THE AWNED SEED OF AGROSTIS VULGARIS, E. H. JENKINS, PH. D. (pp. 247–249).—"The species *Agrostis vulgaris* has at least two very distinct agricultural varieties well known to farmers in the Eastern States and very likely elsewhere; one is the coarse redtop, called by Gould, *A. vulgaris major*, the other *A. vulgaris minor*, variously called fine bent, furze-top, and Rhode Island bent. A popular description of these varieties by J. B. Olcott may be found in the Report of this station for 1887, p. 177.

"Awns on the palets of coarse redtop are unknown, but in old pastures where fine bent grows, plants with awned palets are occasionally found. The awns are upwardly barbed, usually geniculate, and attached very near the base of the palet. The plants which bear them do not differ strikingly in appearance from the others which are not awned.

"An experiment was begun in 1888 to learn whether awned seed produces plants bearing only awned seed or a larger proportion of awned seed than is produced by plants grown from seed destitute of awns." Awned seed of the fine bent variety were sown at the station in 1888 and produced seed in 1889, with the following results: Of 679 panicles examined there were 465 fully awned, 208 with a few awns, and 6 with no awns. "Comment on the results is reserved till further data have been gathered."

COMPARISON OF SOLVENTS FOR FAT IN FEEDING STUFFS, R. S. CURTISS, PH. B. (pp. 250–253).—These experiments were made to compare ether, petroleum-benzine, and chloroform in their action on feeding stuffs, particularly with reference to chlorophyl, which it has been claimed is not dissolved by petroleum-benzine. On this ground it has been proposed to substitute benzine for ether in the determination of fat.

Two fractions were prepared from petroleum-benzine, one distilling over at 55–60° C., the other at 75–80° C. The fraction distilling off from gasoline between 45 and 50° C. was also used. Both the ether and the chloroform were dried over calcium chloride and distilled. These solvents were compared on *Typha latifolia* (common cat's-tail), *Agrostis alba*, *Juncus gerardi* (late cutting and the young aftermath), new-process linseed meal, and gluten meal, these materials being in all cases dried

at 100° C. in a current of hydrogen previous to extraction. A table gives the percentage of extract with the different solvents from each material.

"It appears from these results that petroleum-benzine and chloroform dissolve chlorophyl quite as readily as ether. In all cases but one benzine extracted considerably less than ether, but it has yet to be shown that the benzine-extract any more nearly represents true fat than the ether-extract.

"Petroleum-benzine is also especially unfit for use as a solvent in quantitative work for the reason that it is an indefinite and variable mixture of a number of solvents, which, as the results indicate, differ in their solvent action on the dry matter of feeding stuffs."

THE DETERMINATION OF PHOSPHORIC ACID IN FERTILIZERS BY THE "CITRATE METHOD," S. W. JOHNSON, M. A., AND T. B. OSBORNE, PH. D. (pp. 254–267).—A recapitulation of the studies of H. L. Wells and others on this subject, together with an investigation by the authors leading to a modification of the method.

In the method as modified "the volume of the solution of the phosphate was in all cases 100 cubic centimeters, and this was mixed with 10 cubic centimeters of a 50 per cent solution of citric acid. After neutralizing with ammonia, 50 cubic centimeters of 'United States magnesia-mixture' (containing twice as much ammonium chloride, but otherwise the same as the German mixture) was slowly added with constant stirring, and when the precipitate had separated 30 cubic centimeters of concentrated ammonia water was poured in. After 2 hours the precipitate was filtered on a Gooch crucible, ignited, and weighed. If the sample analyzed had more than 10 per cent of phosphoric acid 1 gram of it was commonly used for the determination. If less than 10 per cent 2 grams were usually employed. In the case of ashes containing soluble-silica this substance was first separated.

"Of sixty-seven comparisons of this modified method with the molybdate method the results of but three differed from the molybdate method by more than 0.3, and but four others by more than 0.2 per cent. The greatest difference was 0.41, the average difference 0.09 per cent. In thirty cases the citrate method gave 0.117 per cent more, on the average, than the molybdate; in thirty-three cases 0.079 per cent. * * *

"The process thus found so satisfactory with a large number of fertilizers gave trouble when applied in the same manner to Thomas slag and Keystone concentrated phosphate. * * *

"To further examine the sources of error involved in this method, several of the ignited and weighed precipitates from determinations by the citrate method were subjected to partial analysis. These analyses indicate that the precipitate is nearly constant in composition whether salts of calcium or those of iron and aluminium preponderate in the solution from which it is thrown down. From the Grand Cayman's phosphate, rich in iron and aluminium, but little more of these metals enters the precipitate than from Carolina rock or bone-black."

Connecticut State Station, Bulletin No. 105, December, 1890 (pp. 8).

THE POTATO SCAB, R. THAXTER, PH. D. (pp. 3, 4).—As the result of several months investigation of potato scab at the station, it is announced that the disease is due "to the direct action of a very peculiar filamentous fungus of extremely small dimensions, which has been found invariably to accompany the disease wherever it has been examined by the writer in New England."

This fungus produces an evanescent gray film in connection with the disease, generally visible without a lens, especially in the earlier stages of the affection, and has been obtained absolutely pure for experiment by the ordinary methods of isolation used in bacteriology. On nearly all neutral or slightly acid substrata used for its cultivation, it forms a compact lichenoid growth accompanied by a peculiar dark stain which diffuses from it through the nutrient substance. Its fructification is aerial and consists in the production of short, rod-like bodies and spirals; the latter terminal, the former resulting from the general segmentation and breaking up of the aerial filaments into short pieces; the general mass, which is bluish-gray in color, closely resembling various forms of bacteria in shape and size; the diameter of both the vegetative and reproductive portions of the plant reaching only from five to eight ten-thousandths of a millimeter on the average. The fungus, which, except for its apparently true-branching and aerial fructification, resembles in some respects certain of the polymorphic bacteria, can not as yet be referred to any described form and answers to no generic description, as far as has been ascertained. It is readily propagated by means of its spores as well as by the smallest possible portions which can be detached from its vegetative filaments. When transferred from pure cultures to young, growing potato tubers, it reproduces the disease upon them with certainty at the point of application, under rigid experimental conditions. * * * Whether the disease under consideration is identical with that which, as previously mentioned, has been referred to a bacterial origin is quite another matter, and there is every reason to believe that the two are wholly distinct affections except in so far as their results are somewhat similar. Further than this nothing can be said, except that the disease here investigated usually takes the form of what has been called "deep" scab, which may possibly be found to be distinct in origin from the "surface" scab with which it is often associated even in New England.

In connection with this subject a study is being made of another organism morphologically identical with the scab fungus, but apparently somewhat different physiologically. This organism, which may nevertheless ultimately prove to be entirely identical with the scab fungus, is one of the commonest forms of growth upon rubbish, old hay or straw, barn-yard manure, and similar substances, and its study is being prosecuted with a view to ascertain whether this identity, if it can be shown to exist, may not furnish a rational explanation of the observed fact that land containing much miscellaneous rubbish or fertilized with barn-yard manure is generally associated with scab in the potatoes raised upon it.

THE PROTEIDS OR ALBUMINOIDS OF THE OAT KERNEL, T. B. OSBORNE, PH. D. (pp. 5–7).—A statement of the results of an extended study of these materials, a brief summary of which was recently given in Experiment Station Record, Vol. II, p. 304. The details of this investigation are to be printed in the Annual Report of the station for 1890.

Delaware Station, Special Bulletin A, March, 1890 (pp. 4).

FUNGICIDES, F. D. CHESTER, M. S.—Formulas for the simple solution of sulphate of copper, Bordeaux mixture, and modified eau celeste, with directions for their use for various diseases of small and large fruits.

Florida Station, Bulletin No. 10, July, 1890 (pp. 31).

REPORT OF DIRECTOR, 1890, J. P. DE PASS (pp. 2–5).—This is for the year ending June 30, 1890, and contains a brief outline of the work of the station at Lake City and of the substation at De Funiak Springs, which is in charge of L. W. Plank.

PHOSPHATE, J. M. PICKELL, PH. D. (pp. 6–31).—A brief account of the history, chemical composition, and physical properties of the deposits of phosphate found in Florida; explanations of the methods used in the manufacture of superphosphate; a discussion of the uses of the phosphates as fertilizers; and tables of analyses of phosphates sent to the station, the analyses being mainly made by J. J. Earle, B. A.

Florida Station, Bulletin No. 11, October, 1890 (pp. 18).

CORN EXPERIMENT (pp. 3–6).—An experiment on five plats, the size of which is not given. One thousand pounds of "pot ammoniac," 1,000 pounds of blood and bone, 1,000 pounds of black cotton-seed meal, and 1 ton of a compost made by mixing 2,000 pounds of stable manure and 333 pounds each of cotton-seed meal, kainit, and acid phosphate, were each used on one plat, the remaining plat receiving no fertilizer. The increased yield over the unfertilized plat, and cost of the increased yield per bushel are given for each plat. The largest yield was with cotton-seed meal, but the cost of the corn per bushel was lowest with the compost.

IRISH-POTATO EXPERIMENT (pp. 6–10).—Notes on 8 varieties of potatoes, and abstracts from Bulletin No. 4 of the Louisiana Stations.

FERTILIZERS (pp. 10, 11).—Notes on the fertilizers used at the station the past season and their effect on orange trees, vegetables, etc.

ANALYSES OF SOME FLORIDA WEEDS AND GRASSES, J. M. PICKELL, PH. D. (pp. 11–18).—A popular discussion of the chemistry of feeding, together with analyses, by J. J. Earle, B. A., of beggar weed (*Desmodium molle*), cotton-head weed (*Froelichia floridana*), sandspur grass (*Cenchrus tribuloides*), wire grass (*Aristida purpurea*), purslane (*Portulaca oleracea*), crab-grass (*Panicum sanguinale*), bull grass (*Eleusine ægyptiaca*), Louisiana grass (*Paspalum platycaule*), Spanish moss (*Tillandsia usneoides* L.). Beggar weed (*Desmodium molle*) is mentioned as deserving of consideration for feeding purposes. Assuming its digestibility to be equal to that of an average hay, the nutritive ratio of this material is given as 1 : 7. "Beggar weed will make two crops of hay. The second crop is said to be less stemmy than the first, and is regarded by some as the very best hay when properly cured."

Louisiana Stations, Third Annual Report, 1890 (pp. 14).

A brief outline of the work of the three stations in Louisiana during 1890, together with a subject list of all the bulletins thus far issued by these stations.

Massachusetts Hatch Station, Meteorological Bulletin No. 25, January, 1891 (pp. 4).

A daily and monthly summary for January, 1891, and an annual summary for 1890, of observations made at the meteorological observatory of the station, in charge of C. D. Warner, B. S.

The annual summary for 1890 is as follows: *Pressure* (in inches).—Actual maximum reading 30.64, January 1, 1 a. m.; actual minimum reading 29.025, October 27, 2 p. m.; mean reduced to sea level 30.03; annual range 1.615. *Air temperature* (in degrees Fah.).—Highest 92, July 8; lowest 2, March 7; mean 47.7; annual range 90; highest mean daily 80, July 31; lowest mean daily 84, December 30; mean maximum 54.3; mean minimum 37.4; mean daily range 16.8; greatest daily range 38, April 13; least daily range 2, February 28, 5.5 April 27. *Humidity.*—Mean dew-point 40.6; mean force of vapor 4,378; mean relative humidity 71.1. *Wind* (prevailing direction).—North 15 per cent; South 11 per cent; Northwest 11 per cent; South Southwest 10 per cent; total movement 54,648 miles; greatest daily movement 410 miles, April 5; least daily movement 18 miles, February 25; mean daily movement 149.6 miles; mean hourly velocity 6.2 miles; maximum pressure per square foot 27.75 pounds=74 miles per hour, January 8, 3 a. m. *Precipitation.*—Total rain-fall or melted snow 39.48 inches; number of days on which .01 of rain or melted snow fell 141; total snow-fall in inches 42.5. *Weather.*—Mean cloudiness observed 57 per cent; total cloudiness recorded by the sun thermometer 2,279 hours, or 51 per cent; number of clear days 137; number of fair days 105; number of cloudy days 123. *Bright sunshine.*—Number of hours recorded 2,194; mean ozone 38 per cent. *Dates of frosts.*—Last, May 12; first, September 25. *Dates of snow.*—Last, April 8; first, October 19. Twenty-two halos were observed; 70 per cent were accompanied by storm within 24 hours, and 61 per cent within 48 hours after the occurrence of the halo.

Michigan Station, Second Annual Report, 1889 (pp. 298).

REPORT OF DIRECTOR, O. CLUTE, M. S. (pp. 11,12).—A brief statement of the way in which the work of the station is conducted.

REPORT OF AGRICULTURIST, S. JOHNSON, M. S. (pp. 15, 16).—A brief outline of the work in this division of the station.

REPORT OF HORTICULTURIST, L. R. TAFT, M. S. (pp. 17-21).—A brief account of experiments with seeds, and with numerous varieties of fruits and vegetables.

Seed testing.—Germination tests of seeds from more than a dozen

seedsmen were made in seed testers, in seed boxes, and in some cases in the open ground. The results, as briefly stated and illustrated in the report, may be summed up as follows: "(1) The seeds were, as a rule, well cleaned and free from foreign seeds. In a few cases they were mixed with other varieties. (2) No seedsman, so far as the tests went, is absolutely reliable. While all of them furnished seeds of a high character as a general rule, packets were frequently found that had a very low per cent of germination, so low in fact that if any reliance had been placed upon them for a crop a failure would have resulted. * * * (3) Our seed tests led us to believe that many if not all seedsmen practice the mixing of their old seeds with the new crop to an extent that can not fail to be injurious to the purchaser."

REPORT OF CHEMIST, R. C. KEDZIE, M. D. (pp. 22-87).

The experimental farm at Grayling (pp. 22-26).—

This farm of 80 acres in Crawford County is in the heart of what is called the pine barrens, and is a fair representative of the light, sandy soils of the State, where the principal forest growth is jack pine (*Pinus banksiana*) and popularly known as jack-pine plains. Along with the jack pine there are found scattering trees of Norway pine, shrubs of scarlet oak, red maple, dwarf huckleberry and sand cherry, sweet fern, brakes, and many kinds of bunch grass. The soil is a yellow to brown sand, having little cohesion and small retentive power. Chemical analysis shows the presence of 94 per cent of sand and insoluble silicates, and only 2 per cent of organic matter. The repeated fires that have swept over these plains explain the deficiency in organic matter in these soils, and afford a reason for the kind of forest growth most common on these plains.

When the land is plowed, after clearing off the trees and shrubs, the soil is usually found too open and porous to sustain crops; the rain sinks too rapidly; the capillary power of the soil to bring up moisture from beneath is too feeble; and the root contact with the soil by the plant too imperfect to secure satisfactory growth.

The two conditions to be secured at the very outset after "breaking the ground," are to increase the amount of vegetable matter in the soil, and to secure a good seed bed by compacting the loose sand. For these purposes three measures have been adopted: (1) to keep out the fires that burn up the annual accumulation on the ground of leaves and vegetable materials and even destroy a part of the organic matter in the soil; (2) to raise on the ground plants that will afford the largest amount of organic matter, to be plowed under as green manure, and thus rapidly increase the organic matter in the soil and available material for the growth of succeeding crops; (3) the free and repeated use of the harrow and roller to compact the soil.

The changes that have been effected in two seasons' growth by these agencies are evident to any one who will examine these experimental fields. The darker color of the soil, its greater firmness, and the increased growth of crops, all bear witness to a favorable change.

The investigation of the capabilities of this soil was conducted entirely on the basis of practical utility, to answer the question whether a man with limited means and unable to buy costly fertilizers, could hope to make a satisfactory farm on the plains. The use of barn-yard manure was rejected for two good reasons: (1) because it had already been demonstrated that large crops could be grown on the sands with a free use of barn-yard manure; and (2) the supply of such manure was too limited for the vast area to be occupied. For similar reasons commercial fertilizers were not used in the experiments. * * * Three manurial substances have been selected for these experiments, viz., marl, plaster, and salt. * * * The marl when

used in doses of 5 tons to the acre has shown marked benefit to all the crops to which it has been applied. The clovers as a class, spurry, lupines, tall fescue, and perennial rye grass, were especially benefited by the marl. * * *

Plaster showed much benefit, especially on the leguminous crops, and paid well for its use. It was used freely, 200 pounds to the acre. In beneficial influence it stood next to marl.

Salt seemed to be of no benefit to any of the crops except buckwheat. To many crops it seemed to be a damage, especially to clovers and millet. It was used at the rate of 200 pounds to the acre. * * *

The following plants have practically been failures on the experimental farm, mainly on account of frost: cow-pea, New Zealand spinach, yellow branching sorghum, martynia, borage, and rape. * * *

The plants [more or less] successful were blue and yellow lupines, Kentucky blue-grass, seven-leaved turnip, timothy (sowed alone), meadow foxtail, * * * spurry, mammoth clover, June clover, alfalfa, white clover, vetch, field peas, Hungarian grass, millet, buckwheat, rye, Bokhara clover, perennial rye grass, tall fescue, and white turnips. * * *

It is difficult to point out on each crop the effect of a green crop plowed under the preceding year; yet the influence was marked in all the crops.

Relation of cultivation to soil moisture (pp. 26–28).—This is a report on observations made at the Michigan Agricultural College and at Grayling:

Specimens of soil were carefully examined for the per cent of moisture they contained at different periods during the growing season from May to October, 1889. Five plats of ground at each station were selected, of uniform character, and in close proximity. The soil at the college was sandy loam; at Grayling, sand. One plat was cultivated repeatedly during the season, viz., at each time of gathering the specimen for analysis. A second plat was raked over with a garden rake at each time of collecting the specimens. A third plat was left without treatment, or in naked fallow with nothing growing on it. A fourth plat was in meadow (timothy sod), but raked with an iron rake at each time of gathering specimens. The fifth plat was timothy meadow, with no treatment. Two sets of specimens were gathered each time, a surface soil, taking the upper 8 inches in each case, and an under soil, taking the soil between 8 and 16 inches from the surface.

The percentages of moisture in the samples analyzed are given in tables, as well as the rain-fall for each month of the same season.

From the 1st of August to the 31st of October there were 2.12 inches of rain-fall at the college, yet the average percentage of water in the cultivated surface soil was 13.89, just 3 per cent more than similar soil left as naked fallow. From September 27 to October 18, without a drop of rain-fall, this cultivated soil increased 2 per cent in moisture without any corresponding change in the layer of soil immediately below it. The raked surface soil had 1 per cent more water than the naked fallow, but 2 per cent less than the cultivated soil.

In the sands at Grayling the benefit from cultivating does not appear, and only slight benefit from raking. The smaller percentage of water in the grass lands in both stations is marked. This might be expected from the large amount of evaporating surface of the grass plants and the demand for moisture from the soil. The raking of the grass was done to see if harrowing or scratching the surface would tend to keep meadows moist the same as plow land. No influence of this kind is apparent.

Soil temperature (pp. 28–45).—Tabulated record of daily observations of soil temperature, at depths of from 3 to 24 inches, at the college and at Grayling for the months of April to October, inclusive, with compar-

ative summaries of the soil temperature in 1888 and 1889 at the college for the months of May to September, inclusive; and at Grayling for the months of June to September, inclusive; and for the months of April to October, 1889, inclusive, at both places.

Sunshine temperature (pp. 46–49).—"These observations relate to the maximum and minimum temperatures taken in open air and with full exposure to the sun. The sun thermometers in vacuum were used, one with bright or mercurial bulb and the other blackened by a coating of lamp-black. These were actinometers rather than thermometers. Two other self-recording thermometers, with bulbs of black glass, were used, one at the college, the other at Grayling. All of these thermometers were placed 10 inches above the ground and results read off daily. A minimum thermometer, placed 4 inches above the ground, was used at each station from April to November." Details are given in tables.

Sunshine record (pp. 49, 50).—A tabulated record of the hours of sunshine daily at the college for the months of April to September, inclusive, in 1888 and 1889.

Summary of meteorological observations at the Michigan Station for the year 1888 (pp. 51–75).—A tabulated record of daily observations for each month of 1888, "in continuation of the series of observations recorded for the Michigan Agricultural College since 1863."

Tile draining in relation to flood and drought (pp. 76–81).—From observations of the effects of cutting off the forests in Michigan and draining the land with surface ditches and tile drains, and from experiments with reference to the percolation of water through dry, damp soils, the following conclusions were reached:

(1) Surface ditching in conjunction with deforesting may increase floods and contribute to droughts.

(2) Tile draining may increase flood at the "break-up" in spring when the water accumulated in the surface soil by the joint action of frost and soil capillarity during the winter, and the surface accumulations in the form of snow are suddenly set free by a rapid thaw.

(3) During the warm months tile draining tends to mitigate flood by taking up the excessive rain-fall and holding it in a capillary form, keeping back the sudden flow that would pass over the surface of the soil if not absorbed by it, and escape by flood; and mitigating summer drought by increased capacity of the soil to hold water in capillary form, and to draw upon the subsoil water supply by reason of the increased capillary power of such soil produced by tile draining.

Miscellaneous analyses (pp. 81–87).—The results are given of analyses of marsh grass, reindeer moss, wheat screenings, wheat bran, and sugar-beets.

REPORT OF ENTOMOLOGIST, A. J. COOK, M. S. (pp. 88–103).—Notes on experiments with arsenites, reported in Bulletin No. 53 of the station (See Experiment Station Record, Vol. I, p. 227); on means of combating the plum curculio; on experiments with insecticides for flea beetles; and on the grain plant-louse (*Aphis avenae*), a new clothes-beetle (*Lasioderma serricorne*), the wee grain beetle (*Silvanus surina-*

mensis), *Trichopoda pennipes* as a parasite of the squash-bug (*Anasa tristis*), and the apple maggot (*Trypeta pomonella*).

Experiments in the apiary (pp. 97–103).—"According to the plans adopted two years ago, the experiments in the apiary are along four lines: testing honey plants to determine whether any will pay for planting and growing exclusively for honey; breeding bees by crossing, in hopes to secure a superior race; analyzing various kinds of honey to ascertain if any test for honey is possible and can be relied upon; and various points in manipulation, etc."

Notes are given on experiments with the Rocky Mountain bee plant (*Cleome integrifolia*), Chapman honey plant (*Echinops sphærocephalus*), a species of Melissa, and Japanese buckwheat. A later account of similar experiments is given in Bulletin No. 65 of the station (See Experiment Station Record, Vol. II, page 279). The cross-breeding of Syrian and Carniolan bees has given promising results. Collections of honey stored rapidly and slowly are being made, with a view to testing the composition of honey. Experiments with chloroform in introducing queen bees into hives and in curing the swarming impulse were successful, but the author is not yet prepared to give positive advice regarding the use of this method. Brief notes are also given on experiments in removing queens during the season of storing honey, in feeding back, and on cuckoo bees.

REPORT OF BOTANIST, W. J. BEAL, PH. D. (pp. 104–115).—Brief notes on experiments with grasses and forage plants at the different stations, on the jack-pine plains, and at the college.

REPORT OF VETERINARIAN, E. A. A. GRANGE, V. S. (pp. 116–118).—Brief notes on immature whip-worms (*Oxyuris curvula*) observed in the fæces of horses affected with colic, and on investigations of actinomycosis.

MICHIGAN STATION BULLETINS NOS. 43–55 (pp. 119–298).—Abstracts of these bulletins were published in Experiment Station Record, Vol. I.

Minnesota Station, Bulletin No. 13, December, 1890 (pp. 38).

A TREATISE ON FLAX CULTURE, O. LUGGER, PH. D. (pp. 3–31, illustrated).—A useful summary of information regarding the cultivation of flax for fiber and seed as it is carried on in Europe. The author is able to draw largely on his experience in flax culture, gained for the most part in the flax growing region of Westphalia. The article also contains a brief preliminary report to the Governor of the State on experiments in 1890 near Windom, Minnesota, by the author, with a view to ascertaining the cause of an obscure disease of flax in which "the stems of the plant assume a yellow color at the base and a blackish one at the tip, and the leaves—and later the stems—die and disappear." The experiments were of three kinds: (1) with fertilizers on land exhausted by flax, (2) with fungicides applied to seed in infested soil, and (3) with infusions prepared from the chaff and straw of flax.

(1) In the experiment with fertilizers 20 pounds of acid phosphate, 10 pounds of lime, "muriate phosphate," salt, nitrate of soda, superphosphate, land plaster, and ground oil-cake were applied singly on one half of the two sixteenth-acre plats used for each fertilizer, the second half receiving double the amount of the fertilizer used on the other half. There were also eight untreated plats. The seeds germinated well on all the plats, but the young plants soon "commenced to shrivel up, and all disappeared before reaching a height of 3 inches," thus indicating that this disease is not due to exhaustion of the soil.

(2) In the experiment with fungicides the seeds, mixed with dry soil, were soaked with sulphide of sodium, sulphate of copper, corrosive sublimate, or lime combined with hyposulphite of sodium, flowers of sulphur, sulphate of copper, or sulphate of iron. The fungicides were applied in solutions of different degrees of strength, but none of the applications proved in any way effective to repress the disease. Microscopic examinations of diseased plants did not reveal any specific organisms as the cause of the disease.

(3) In the third series of experiments some plats were moistened with an extract made by soaking the chaff or straw of flax in cold or boiling water; one plat was covered with dry healthy chaff, another with dry diseased chaff, and another with green straw of healthy plants cut into small pieces. A similar experiment was made with an extract of healthy fresh plants in a region free from the disease. In both cases the treated plats suffered from the disease, while those untreated were not affected by it. The indications, therefore, are that, as experience in Europe shows, flax is "unkind" to flax, *i. e.* flax will not do well on land cropped with flax the previous year. Investigations of this matter will be continued by the author in the laboratory.

STRUCTURE OF THE FLAX STEM, H. L. OSBORN, PH. D. (pp. 31–38, illustrated).—A popular account of the structure of the stem of the flax, to explain the nature of the fiber and the operations necessary for its preparation.

Minnesota Station, Bulletin No. 14, January, 1891 (pp. 24).

PIG FEEDING FOR PROFIT, N. W. MCLAIN, LL. B. (pp. 41–45).—"For the purpose of demonstrating something of practical value to the farmers and swine growers of the State," fifty-four Duroc-Jersey pigs, farrowed by seven sows, were raised and fattened for the market. An accurate account was kept of the cost of the food consumed by the sows and pigs from the birth of the latter to the time of slaughtering, and an allowance of $36 made for the care of the animals during about 11 months. Through the summer the pigs ran in a brush pasture furnishing very little feed. Three times a day they were fed all they would eat of "meal screenings," either steamed or mixed with water. During September a part of the meal was replaced by green corn, and during October by corn on the cob. From October to January 25 the food

consisted of corn on the cob, and from January 25 to March 14—the time of selling—of shelled corn either boiled or soaked. The cost of "meal screenings" was 30 cents per 100 pounds, and that of shelled corn 30 cents per bushel. The pigs were sold when about 11 months old at 4 cents per pound. The financial statement was as follows:

Receipts for fifty-four pigs, weighing 15,820 pounds, at 4 cents a pound		$632.80
Total cost of food for pigs and sows	$280.40	
Care of pigs	36.00	
		316.40
Net profit		316.40

The cost of producing 1 pound of pork at different periods was as follows:

Cost of food per pound of pork.

Periods.	Total gain of 54 pigs.	Cost of feed for same.	Cost of feed per pound of pork.
	Pounds		*Cents.*
April 15 to December 24	11,360	$147.68	1.3
December 24 to January 18	2,000	56.32	2.8
January 18 to March 14	2,460	76.40	3.1

The pigs could have been sold December 24 at $3\frac{1}{2}$ cents per pound; on January 18, at $3\frac{3}{4}$ cents.

SWINE BREEDING, N. W. MCLAIN, LL. B. (pp. 45–53).—Remarks are made under this head on the rules of breeding in general, crossing of breeds, characteristics of several prominent breeds, the "special purpose pig," food and shelter, and a plea is made for improvement in the methods of breeding and raising pigs practiced in Minnesota.

SUGAR-BEETS, D. N. HARPER, PH. D., AND W. M. HAYS, B. S. A. (pp. 54–64).—This includes a tabulated record of analyses of 55 samples of different varieties of sugar-beets grown in 1890 at different places in Minnesota, and a compiled account of the methods of cultivation of sugar-beets and the processes of the manufacture of beet sugar, together with statements regarding the results of sugar-beet culture in Nebraska in 1889 and 1890. In the samples analyzed at the station the per cent of sugar ranged from 5.24 to 17.92, being over 12 per cent in 40 out of the 55 samples examined.

Nebraska Station, Third Annual Report, 1889 (pp. 27)

This includes a brief outline of the work of the station during 1889 in agriculture, chemistry, physics, geology, soils, irrigation, entomology, and botany; the report of a visiting committee, consisting of two members of the State Agricultural Society and one of the State Horticultural Society; the treasurer's report; and a subject list of the publications of the station issued during 1888 and 1889.

New Jersey Stations, Bulletin No. 77, December 11, 1890 (pp. 36).

EXPERIMENTS WITH DIFFERENT BREEDS OF DAIRY COWS.—In May, 1889, a series of experiments was commenced with Ayrshire, Guernsey, Holstein-Friesian, Jersey, and Shorthorn cows, the object of which was "to determine by carefully planned and executed experiments the cost and value of the products from each of the different breeds." Three representative animals of each breed were selected by committees from associations interested in the several breeds. "It was clearly recognized from the beginning that the management of the animals was of the greatest importance. The feeding and care were therefore so conducted as to give full credit to the special characteristics of the different breeds." Reports of the progress of the experiments have been made from time to time (See Bulletins Nos. 57, 61, 65, and 68 of the station; also Experiment Station Record, Vol. I, pp. 258 and 260, and Vol. II, pp. 162 and 241), including data relative to the quantity and quality of the milk of each cow, and the food consumed. The experiment was prematurely terminated by a fire November 2, 1890, which burned the barns of the Agricultural College and the entire herd of cows. The station had not contemplated an end of the experiments for a considerable period, and the records so far secured, while presenting many points of interest and of value, are too limited to warrant detailed conclusions in regard to the main question, to which all the lines of work were directed, viz., a comparison of the different dairy breeds.

This bulletin completes the record of food eaten, milk produced, and chemical analyses of milk of each cow up to November 1, 1890, and contains in addition "a summarized statement of the whole work, with such conclusions from chemical data as shall be fair to all concerned." The data given include for each breed the analyses of the milk for 8 months (March to November, 1890); the average composition of the total solids in the milk; the amount and cost of food consumed and milk produced from May 1, 1889, to October 31, 1890; the average composition of the milk for 11 months (December, 1889, to November, 1890), and the average cost of food per quart of milk, per pound of total solids, and per pound of fat during the same period.

The amount and proportion of the food compounds furnished the herds in the daily rations since December, 1889, remained practically constant. The green food and pasture during the summer months were fed in such quantities as to substitute the coarse materials fed during the remainder of the year.

As noted previously, complete chemical analysis of the milk was made every other day. The changes in the composition of the milk for short periods were not noticeable when equal conditions were maintained.

The total solids in the milk of all the breeds was lowest during the summer months; a gradual decrease in quality was noticed from April to June and an increase from September, though the actual food compounds eaten were as uniform as possible and the period of greatest milk flow did not occur for all the animals during the months from June to September, inclusive. It would seem, therefore, that summer

conditions of food and weather, which as a rule favorably influenced milk flow, did so at the expense of quality. * * *

The analyses show also that in the month of June there was a decided change in the relative amounts of the casein and sugar in the milk of all the breeds, viz., a decrease in the per cent of casein, and an increase in the sugar. That this change in the relation of these compounds influenced the specific gravity of the milk is undoubted, though the exact cause of the change in composition of the milk in this month must be determined by further study. * * *

The Guernseys were dry for the shortest period; the Ayrshires and Jerseys would each average about 1 month, and the Holstein-Friesians and Shorthorns about 2 months per year. There are conditions of dairy farming when this point would be of considerable importance in the selection of animals.

The cost of food consumed was secured from the prices actually paid for concentrated feeding stuffs and by fixing market values on produce raised on the farm, and is uniform throughout for all the breeds. The prices used were as follows: hay, $10 per ton; wheat bran, $17.60; corn and oat meal, $20.40; cotton-seed meal, $25.40; linseed meal, $29.40; gluten meal, $22.50; oil meal, $25; dried brewers' grains, $16.60; corn stalks, $6; green fodder, $2.50; silage corn, $3.50; roots, $8 per ton; and pasture, 10 cents per day of 12 hours. * * *

In table 5 the column containing the average yield of milk per day indicates that on the basis of milk production the five breeds represent three classes, the Guernseys and Jerseys going together as before, with an average of 8.5 quarts: the Ayrshires and Shorthorns, with an average of 9 quarts; and the Holsteins, a class by themselves, with an average daily yield of 11 quarts—23 per cent greater than the first and 18 per cent greater than the second.

The average cost of the daily rations also varies considerably and in such a manner as to make the average cost of food per quart of milk very uniform, the lowest, 1.66 cents, being for the Ayrshires, and the difference between the highest and lowest cost but one quarter of a cent. It should be said, however, that in the case of the Holsteins, the cost of the ration was considerably increased by the fact that the amount of coarse fodder eaten by them was greater than in the other breeds and consisted largely of timothy hay, one of the most expensive foods eaten, which probably did not materially aid in milk production.

It is shown in table 6 that the breed giving the lowest average per cent of solids in the milk [Holstein-Friesians] produces the greatest amount of milk per day, and that in this breed it is produced in such quantity as to yield the greatest amount of total solids daily. What is true of the Holsteins, however, is not true of the Ayrshires and Shorthorns, for in the case of those breeds the lower quality is not accompanied by a proportionate increase in yield, and the average daily solids is lowest.

A study of table 7 develops the fact that the cost of food per pound of fat is low in those breeds whose milk shows a high content of fat, and high in those showing a low content of fat; but that the lowest daily averages are not accompanied by the highest cost, and that, on the basis of cost per pound of butter, the breeds are again divided into three classes, which correspond exactly to those shown when the basis is average daily yield of milk, viz., the Guernseys and Jerseys, the Ayrshires and Shorthorns, and the Holstein-Friesians by themselves. The cost per pound of butter fat, as a rule, is greatest in the breeds whose average daily yield of milk is the largest.

Studied under the conditions which now largely rule in the sale of the distinct dairy products, milk and butter, and which must define the present methods of comparison of breeds from the commercial standpoint, the results show that all the breeds do not present the same points of comparison, but are divided into distinct classes, one milk, the other butter. In the milk class the average cost of a quart of milk is less than in the butter class, and in the butter class the average cost of a pound of butter is less than in the milk class.

New Jersey Stations, Bulletin No. 78, January 30, 1891 (pp. 14).

DESTROY THE BLACK KNOT OF PLUM AND CHERRY.—AN APPEAL, B. D. HALSTED, D. SC. (illustrated).—A bulletin of information on the black knot (*Plowrightia morbosa*) and the means for its repression, and an appeal to fruit growers and farmers to work for the eradication of this pest.

New Jersey Stations, Special Bulletin L, April 2?, 1890 (pp. 3).

OBSERVATIONS ON THE PEACH FOR 1890, B. D. HALSTED, D. SC.—A list of questions addressed to peach growers in New Jersey in view of the probability that the peach crop had been seriously damaged by the warm winter and cold spring of 1890.

New York Cornell Station, Third Annual Report, 1890 (pp. 54).

REPORT OF DIRECTOR, I. P. ROBERTS, M. AGR. (pp. 1–14, illustrated).—A brief history of the station, an illustrated description of the proposed Agricultural Hall for the use of divisions of the College of Agriculture and the station, a brief account of the university farm, and illustrated descriptions of the farm barn and dairy-house.

Twenty-five bulletins, of eight to ten thousand copies each, and two annual reports have been issued during the 32 months that the station has been established. A large amount of work, which is believed to have been of direct and immediate value to agriculture, but which can not be set forth in bulletins, has been done during the year. The station staff have given many addresses at the various meetings of agriculturists, have answered numerous inquiries through the press and by letter, and have visited several sections of the State in order to render assistance in solving difficulties of a general character.

The mailing list has reached 12,000, and 6,000 persons have acknowledged the receipt of the bulletins. Several hundred letters received annually from the progressive farmers of the State in commendation of the work done, testify to the full appreciation of the value of the station.

In accordance with the law, one copy of each publication is sent to each of the 1,700 papers published in the State; this wise provision enables us to reach nearly a million readers monthly.

REPORT OF CHEMIST, G. C. CALDWELL, PH. D. (pp. 17–21, illustrated).—An illustrated description of that portion of the new chemical laboratory of the university which has been set apart for the use of the station.

REPORT OF BOTANIST, A. N. PRENTISS, M. S. (pp. 22–28, illustrated).—An illustrated account of the laboratories, plant-houses, herbaria, grounds, and the equipment of the botanical division of the station.

REPORT OF CRYPTOGAMIC BOTANIST, W. R. DUDLEY, M. S. (pp. 29–34, illustrated).—An illustrated account of the laboratory and equipment for the work on the diseases of plants, in which this division of the station is especially engaged. There are brief references to the work of the division, a portion of which has been reported in bulletins.

From investigations of the leaf blight of the quince (*Entomosporium maculatum*, Lev.) we are enabled to say that the hibernation of the species must be chiefly by means of the ordinary spores, and not by ascospores. The former were found on the fallen leaves at various times during the winter, and were capable of germination and vigorous growth. Experiments showed that these spores directly infected the host when sown on plants especially cultivated for the purpose, and we believe, although the evidence is not wholly conclusive, that in nature the source of infection in the spring is wholly from the fallen leaves of the previous year or from the soil upon which they have rested, and that the spores are probably blown in the rain or dust to the young quince leaves. The utility of complete destruction of all diseased leaves as fast as they appear, especially in quince nurseries, is at once obvious; and the raking up in the autumn and burning of all fallen leaves and waste fruits in quince orchards is advised. Spores could not be found lodged in bark or bud scales in close proximity to the opening bud, as we had expected; indeed, none of our investigations thus far indicate a source of infection other than we have described. * * *

It is clear that certain varieties are more susceptible to the attack of this parasite than others. As an illustration, the Angers was badly infested, but the Meech, growing beside the former on the university grounds, was nearly free.

[Studies on the apple-scab fungus (*Fusicladium dendriticum*), subsequent to those mentioned in Bulletin No. 19 of the station (See Experiment Station Record, Vol. II, p. 246), indicated that] the failure of the apple crop during the last season was probably due primarily to a physiological disturbance (too low temperature at the time of the blossoming, it is thought); the young fruits which survived this first shock were then attacked by the apple scab and the curculio, the conditions favoring the activity of both. The trees were also weakened by the attack on the foliage of the apple scab, and the wholesale destruction of the crop under these circumstances is not surprising. Careful observations will be made in the future to ascertain if the fungus does or does not attack the flowers, as work will be continued on this disease during the winter and spring. * * *

A series of experiments on the optimal temperature of germinating spores has been instituted. A few species only have been taken up, but thus far fungi which thrive best in a cold, wet season are found to prefer a low germinating temperature [See Bulletin No. 24 of the station, and Experiment Station Record, Vol. II, p. 421]. Those thriving in a hot summer show a correspondingly high optimal temperature.

It is not difficult to see that definite information on the limits of germination of the spores of each of our troublesome fungous parasites might be of great service to owners of greenhouses and forcing-houses. The preservation of a specific temperature, not injurious to the host plant, might deprive the fungus in certain cases of its power of attack.

REPORT OF ENTOMOLOGIST, J. H. COMSTOCK, B. S. (pp. 35-42, illustrated).—An illustrated description of the insectary, an account of the collections in entomology belonging to the station, and brief notes on the work of the year. The results of experiments with insecticides for wire-worms will soon be published, though thus far they are chiefly negative. It has been determined that the most common species of wire-worms can not be destroyed by the use of salt in quantities not injurious to crops. "We have also demonstrated the impracticability of starving wire-worms in the soil by sowing either buckwheat or mustard, as has often been recommended, or even by starving them by clean fallow." Observations have shown that though the wire-worm matures in the latter part of the summer the adult remains in its cell in the ground till the following spring.

"In every case where the soil in the breeding cages was disturbed after the insects had transformed the beetles perished in the soil. The only way in which we have been able to rear active adults has been to leave the soil in the breeding cages undisturbed from midsummer till the following spring.

"This experience clearly indicates that by fall plowing we can destroy the beetles in the soil, and thus prevent their maturing and depositing eggs the following season."

REPORT OF AGRICULTURIST, H. H. WING, B. AGR. (pp. 43, 44).—A brief outline of the work of the year. Experiments in the breeding of pigs and in the breeding and feeding of poultry have been undertaken.

REPORT OF HORTICULTURIST, L. H. BAILEY, M. S. (pp. 45–54, illustrated).—An illustrated description of the plant-houses, barn, plantations, and garden herbarium of this division of the station, with notes on the work in progress. The experiments in crossing and hybridization, the influence of electric light on the growth of plants, the effect of fertilizers on fruit-trees, and methods of propagating and forcing plants are considered of special importance. The results of some of these will be published before long.

Many secondary investigations are under way, of which the following may be mentioned: an experiment with the cultivation of huckleberries, both at the station and upon a piece of land in the eastern part of the State; tests of edible plants of foreign countries to determine which ones give promise in this State; tests in the automatic ventilation of greenhouses, and several other features of greenhouse construction; a large experiment to determine the influence of food, chiefly concentrated fertilizers, upon the variation of plants; a large experiment with hardy foreign and domestic roses; a systematic study of horse radish, with particular reference to propagation and improvement; and at all times the study of the species and the variation of plants under culture. In all our work photography is used freely as a means of preserving accurate records.

New York Cornell Station, Bulletin No. 25, December, 1890 (pp. 44).

MILK, H. SNYDER, B. S. (pp. 143–151).—*Method of analysis.*—The gravimetric asbestos method described by S. M. Babcock, is used at this station. the tubes used being the fodder tubes described by G. C. Caldwell (See New York Cornell Station Bulletin No. 12, or Experiment Station Record, Vol. I, p. 278). The working of the method is described.

Comparison of the asbestos and paper methods.—Three comparisons of the Babcock asbestos method with the Adams method of drying the milk on coils of filter paper are reported. The largest difference in solids was 0.11 per cent in favor of the Adams, and in fat 0.08 per cent in favor of the Babcock method.

Asbestos appears to be superior to paper. Corrections are always necessary on account of the ether-soluble matter in the paper coils. This is a variable quantity, and when a sample of milk has become acid the paper will give up a much larger quantity of extract. With skim-milk or buttermilk this frequently amounts to a third or a half of the total weight of fat obtained, and in case the skim-milk or butter-

milk is acid, which so frequently occurs, the amount of paper extract will even equal or exceed the weight of fat present. The paper method can not be used with satisfaction or safety on skim-milk or buttermilk, while the ignited asbestos can be.

Comparison of Babcock's centrifugal method with the gravimetric method.—The results of determinations of fat by the centrifugal method, described by S. M. Babcock in Wisconsin Station Bulletin No. 24 (See Experiment Station Record, Vol. II, p. 256), were compared with those by the gravimetric in seventeen duplicate trials. The largest difference, 0.19 per cent of fat, occurred in a sample of watered milk which had been kept 24 hours. The difference did not exceed 0.13 per cent in any other case. The author considers that "for the use of dairymen this is the most rapid and accurate method which has yet been tested in this laboratory."

On the effect of a grain ration for cows at pasture.—Tabulated analyses of milk already reported in connection with a feeding experiment in Bulletin No. 22 of the station (See Experiment Station Record, Vol. II, p. 369).

Cream raising by dilution.—Tabulated data on this subject already reported in Bulletin No. 20 of the station (See Experiment Station Record, Vol. II, p. 284), together with the results of four additional trials.

Variations in fat of milk served to customers in dipping from cans.—A reprint of the analyses published in connection with this test in Bulletin No. 20 of the station (See Experiment Station Record, Vol. II, p. 286).

Miscellaneous milk analyses.—This includes the composition of the mixed milk from the same herd in December and in August, composition of milk from a cow having udder inflammation, and analyses of cream. "In ten samples of cream in which the fats only were determined, the percentages ranged from 14.40 to 28.15."

ANALYSES OF CATTLE FOODS, W. P. CUTTER, B. S. (p. 151).—Analyses of corn meal, flesh meal, linseed meal, cotton-seed meal, wheat middlings, silage, corn, corn cobs, red beets, malt sprouts, hay, clover hay, red clover hay, timothy hay, and pea hulls, with reference to their value as feed.

MISCELLANEOUS ANALYSES, H. SNYDER, B. S. (pp. 152, 153).—Analyses are given of wood ashes, tankage, sea-grass and mud, a 2-year-old apple-tree, "milk and cream preservaline," blood from a sheep, and evaporated apples. One kilogram of the apples contained 0.583 gram of zinc, believed to have come from the pans used for evaporating.

HOLLYHOCK RUST, W. R. DUDLEY, M. S. (pp. 154, 155, illustrated).—A brief account of the fungus causing hollyhock rust (*Puccinia malvacearum*, Mont.), and the formula for a remedy which has been found effective. This formula, which is taken from the Gardeners' Chronicle for 1874, p. 243, is as follows: permanganate of potash (sat. sol.), 2 tablespoonfuls; water, 1 quart. Apply to the spots and all diseased parts with a sponge, and not a syringe or sprayer. This disease has

only recently appeared in the United States, but is apparently spreading. It was observed in a number of places in New York in 1890. European experience shows that it is very desirable for our gardeners to make every effort to bring it under control.

THE EFFECT OF REMOVING THE TASSELS ON THE PROLIFICACY OF CORN, I. P. ROBERTS, M. AGR. (pp. 156–159).—A report of an experiment to test the theory that if the tassels are removed from corn before they have produced pollen the yield of grain will be increased. On a plat planted with Sibley's Pride of the North corn in 48 rows of 42 hills each, the tassels were removed from each alternate row as soon as they appeared. The results are tabulated in detail for each row and are summed up in the following table:

	Aggregate yield.		Comparative yield.	
	Tassels left on.	Tassels removed.	Tassels left on.	Tassels removed.
Number of good ears	1,551	2,338	100	151
Number of poor ears	628	885	100	141
Number of abortive ears	2,566	951	100	37
Total number of ears	4,745	4,174	100	88
Weight of merchantable corn ....pounds	710	1,078	100	152
Weight of poor corn ....do	130	187	100	144
Number of stalks	4,186	4,228	100	101
100 stalks weighed ....pounds	82	79	100	96

While for a single trial the results of this experiment seem particularly marked and conclusive, it yet remains to be determined whether it will pay for a farmer to remove any considerable proportion of the tassels from his corn; what proportion it will be best to remove (for some evidently must be left); and whether all that it is advisable to remove may be taken off at one time or not. So far as we could estimate the time taken, it certainly paid us from a commercial standpoint to remove all the tassels from one half the rows this year. It is also still to be determined whether the removal of the tassels would be followed with the same effect in a season and on a soil where there was abundant moisture for all the needs of the plant at the time when the tassels were shooting and the ears forming.

ANALYSES OF SUGAR-BEETS, I. P. ROBERTS, M. AGR., AND H. SNYDER, B. S. (pp. 159, 160).—Analyses of 5 varieties of sugar-beets grown at the station in 1890 and of 1 variety grown at two other places in New York, show a total per cent of sugar ranging from 7.93 to 11.64. In this case "the crops producing the greatest yield per acre gave beets containing the largest percentage of sugar."

SUGAR-BEETS AS STOCK FOOD, I. P. ROBERTS, M. AGR. (pp. 160–162).—The 5 varieties of sugar-beets grown at the station in 1890 gave an average yield of 23.1 tons per acre, while the single variety (Long Red) of mangels grown in comparison with the beets yielded 31.4 tons. One variety (Bulteau Desprez's Richest) of the beets, however, yielded 35 tons per acre. Analyses of the beets and mangels as given in this article show less water and more nitrogen-free extract in the beets than in the mangels. Taking the average yields as given above, the amounts of dry matter per acre in the two crops was about equal. Practically, therefore, the greater difference in growing and harvesting the

beets was the important difference between the two crops in this experiment.

THE EFFECT ON FOWLS OF NITROGENOUS AND CARBONACEOUS RATIONS, I. P. ROBERTS, M. AGR., AND J. E. RICE, B. S. (pp. 162-169, illustrated).—On July 2, 1889, 10 Plymouth Rock hens, 1 year old, and as nearly as possible of uniform size, were selected from a flock of 35. At the same time 10 chickens, hatched from the same hens mated with a Plymouth Rock cock, were similarly chosen. The chickens were about 6 weeks old, healthy and vigorous and of nearly the same size.

After a preliminary feeding trial of 25 days the hens and chickens were each separated into two lots of 5 each and were fed 125 days. Lot 1 of both hens and chickens were fed a nitrogenous ration consisting of one third part wheat bran, one third part wheat shorts, one third part cotton-seed meal, and 2 parts skim-milk. Lot 2 were fed a carbonaceous ration of cracked corn and corn dough. Both lots were given a small amount of green clover as long as it lasted, and afterward cabbage. The details of the experiment are given in notes and tables.

Eggs laid and gain in weight—hens.

	Live weight.			No. of eggs laid	Weight of eggs laid.	Average weight of eggs.	Gain in weight, including eggs.
	July 26.	Nov. 27.	Loss				
	Pounds.	*Pounds.*	*Pounds*		*Pounds.*	*Ounces*	*Pounds*
Lot I.—Nitrogenous	23.53	21.31	2.22	79	8.25	1.67	6.03
Lot II.—Carbonaceous	23.56	22.00	1.55	26	2.92	1.80	1.36

Gain in live weight—chickens.

	Live weight		Gain.	
	July 26.	Nov. 27	Pounds	Per cent.
Lot I.—Nitrogenous	8.94	17.89	8.95	100.11
Lot II.—Carbonaceous	9.06	12.63	3.57	39.40

It will thus be seen that while both lots of hens lost weight during the experiment, the loss was slightly greater with those fed nitrogenous food, but these produced by far the most eggs.

The chickens fed on nitrogenous food just about doubled in weight, while those fed carbonaceous food only added about one third to their weight. * * *

At the end of the experiment little difference could be seen in the hens of the two groups, but the two lots of chickens were in striking contrast. While the chickens fed on nitrogenous food were large, plump, healthy, active, and well feathered, the chickens fed on a carbonaceous ration were in general much smaller, sickly, and in several cases almost destitute of feathers. Two of them had perfectly bare backs and so ravenous were they for flesh and blood that they began eating one another.

The eggs laid by the nitrogenous-fed hens were of small size, having a disagreeable flavor and smell, watery albumen, an especially small, dark-colored yolk, with a tender vitelline membrane, which turned black after being kept several weeks, while the eggs of the carbonaceous-fed hens were large, of fine flavor, of natural smell,

large normal albumen, an especially large, rich, yellow yolk, with strong vitelline membrane, which was perfectly preserved after being kept for weeks in the same brine with the other eggs.

The fowls were slaughtered November 27. Their dressed weights and the weights of their different parts were as follows:

Dressed weight, internal organs, etc.

	Live weight	Dressed weight	Dressed weight per cent	Weight of— Blood	Feathers.	Intestinal fat.	Offal	Bones	Flesh.
Hens	*Lbs.*	*Lbs.*	*Lbs*	*Lbs*	*Lbs.*	*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*
Lot I —Nitrogenous ..	21 31	14 86	69 7	0 75	1.41	0 59	3 70	3.47	11 39
Lot II —Carbonaceous	22 00	15.09	68.6	0.66	1.25	1.98	3.02	3.63	11.47
Chickens.									
Lot I Nitrogenous .	17 89	12.01	67.1	0 55	1.28	0 34	3.62	3.18	8 93
Lot II. Carbonaceous	12 63	8.89	70 5	0.34	0 66	0.60	2 08	2.69	6.20

The breaking strain of the right tibia was as follows for the hens and chickens of the various lots:

	Average. Hens.	Chickens
Nitrogenous .	48 16	46 64
Carbonaceous	51 74	31 18

The difference in the composition of the flesh, as shown by the analysis of Mr. W. P. Cutter, is given below:

	Albuminoids.	Fat.
Hens.		
Lot I—Nitrogenous	43 81	12 59
Lot II—Carbonaceous	25.13	20.76
Chickens:		
Lot I Nitrogenous	52 00	5 51
Lot II Carbonaceous	30 06	11.34

The flesh of each group was submitted to a number of persons for a cooking test, and the almost unanimous verdict was that the flesh of the fowls fed a nitrogenous ration was darker colored, more succulent, more tender, and better flavored, though on this last there was some difference of opinion.

THE FORCING OF BEANS, L. H. BAILEY, M. S. (pp. 170–172, illustrated).—A brief account of the method pursued by the author in forcing bush beans in the greenhouse for the winter market.

"The essentials of a forcing bean are compact and rapid growth, earliness, productiveness, and long, straight, and symmetrical pods. The Sion House answers these requirements the best of any variety which we have yet tried."

INFLUENCE OF LATITUDE UPON POTATOES.—A CRITICISM, L. H. BAILEY, M. S. (pp. 173–175).—Tests by the author in 1889 and 1890 of the sprouting (in storage) and of the yields of different varieties of potatoes from Northern and Southern seed are cited to show the unreliability of present methods of experimenting in this line.

The variations in these potatoes were no doubt due much more to the stock itself—how it had been grown and handled in previous years—than to any influences of

latitude. In other words, I believe that it is impossible to secure stock from different growers which is uniform enough to allow of comparative experimentation; and this is as true in other plants as in potatoes. If this generalization is correct, we must modify many of our methods of experimentation. In order to secure a uniform stock, it must be grown in the same place and under the same conditions for several years, and this can then be distributed to various growers and after a time returned to be grown again side by side for comparison. And even here it will be difficult to eliminate uncertainties. But in this line we shall now work upon our studies of the influence of latitude upon plants.

NOTES UPON METHODS OF HERBACEOUS GRAFTING, L. H. BAILEY, M. S. (pp. 175–177).—Brief notes are given on experiments in grafting, performed by J. R. Lochary under the supervision of the author.

The experiments were undertaken primarily for the purpose of learning the best methods of grafting herbs, but a secondary and more important object was the study of the reciprocal influences of stock and scion, particularly in relation to variegation and coloration. This second feature of the work is still under way in one form or another, and we hope for definite results in a few years. * * *

Six hundred grafts were made in our trials last winter. It was found that the wood must be somewhat hardened to secure best results. The very soft and flabby shoots are likely to be injured in the operation of grafting, and union does not take place readily. * * * Various styles of grafting were employed, of which the common cleft and the veneer or side graft were perhaps the most satisfactory. In most instances it was only necessary to bind the parts together snugly with bass or raffia. * * *

[Among the experiments were the following:] Tomatoes upon potatoes and potatoes upon tomatoes grew well and were transplanted to the open ground, where some of them grew, flowered, and fruited until killed by frost. The tomato on potato plants bore good tomatoes above and good potatoes beneath, even though no sprouts from the potato stock were allowed to grow. Peppers united with tomatoes, and tomatoes with peppers. Egg-plants, tomatoes, and peppers grew upon the European husk tomato or alkekengi (*Physalis alkekengi*). Peppers and egg-plants united with each other reciprocally. Pumpkin vines united with squash vines, cucumbers with cucumbers, musk-melons with water-melons, and musk-melons, water-melons, and cucumbers with the wild cucumber or balsam apple (*Echinocystis lobata*).

Another interesting feature of the work was the grafting of one fruit upon another, as a tomato fruit upon a tomato fruit or a cucumber upon another cucumber. This work is still under progress, and it promises some interesting results in a new and unexpected direction, reports of which may be expected later.

THE INFLUENCE OF DEPTH OF TRANSPLANTING UPON THE HEADING OF CABBAGES, L. H. BAILEY, M. S. (p. 178).—Brief notes on an experiment in 1890 in the deep and shallow planting of Early Wakefield cabbages.

"Shallow planting gave better results than deep planting, both in the percentage of good heads and in the weight of heads. In 1889, in a larger experiment [with 13 varieties, reported in Bulletin No. 15 of the station and Experiment Station Record, Vol. I, p. 283], the comparative results of the two methods were indifferent. We feel, therefore, that the common notion that deep transplanting is essential to success in cabbage growing is at least doubtful."

PEACH YELLOWS, L. H. BAILEY, M. S. (pp. 178–180).—In this article attention is called to the investigations of this disease and to its

destructiveness in certain States, in order to urge the importance of enforcing the New York law against it.

THE PAPER FLOWER-POT, L. H. BAILEY, M. S. (p. 180).—From tests made by the author it appears that the paper flower-pot is "a good thing both in which to ship plants and in which to grow rapidly growing stock for sale."

EXPERIENCE IN CROSSING CUCURBITS, L. H. BAILEY, M. S. (pp. 180–187).—The author is engaged in an extensive investigation on the crossing of cucurbits. He has already "made fully 1,000 careful hand pollinations, and obtained no less than 1,000 types of pumpkins and squashes never recorded. The plantations of selections and crosses covered some eight acres this year. The experiment is only begun. The main results of it can not be announced until further work has been done. But some of the incidental features of the research can be stated from time to time."

In this article several topics are discussed as indicated below:

(1) *Immediate effect of crossing.*—"The 'immediate effect of crossing' is a term used to denote any change which may occur in the fruit the same year the cross is made, as a result of the influence of pollen. Whatever effect the pollen may have is usually shown in the offspring of the crossed fruit rather than immediately, the same season, in the fruit itself. There are but few plants in which an immediate effect of crossing has been proved, and of these Indian corn is the most familiar. It is commonly said that it occurs in pumpkins and squashes also, but it certainly does not. There has never been any immediate influence whatever in any of our crosses, except such as was due to imperfect development caused by insufficient or impotent pollen. In other words, the effects of the cross are seen only in the offspring of the fruits. * * *

"The same observation can be made with reference to blackberries and raspberries. Over 250 successful hand pollinations were made this year between blackberries, raspberries, and dew-berries in many combinations, and there were no immediate effects."

(2) *Do pumpkins and squashes mix?*—"Before considering the question, it is necessary to divide the fruits called squashes into two groups. One group includes the summer and fall squashes, like the scallops, common crook-necks, cocoanut, Bergen, and the like; these belong to the same species as the field pumpkin (*Cucurbita pepo*). These squashes cross with the ordinary field pumpkin and with each other, although even here the mixing does not appear to be indiscriminate. The other group includes the Hubbard, Marblehead, Turbans, and so-called Mammoth squashes, and pumpkins like Mammoth Chili, and Valparaiso; these belong to a distinct species (*Cucurbita maxima*). Many careful pollinations have been made between these two classes of fruits, and in no case have seeds been procured. Sometimes the fruit will develop for a time, and in two or three instances a summer crookneck pollinated

by a turban squash has developed until half grown, and has then persisted until the end of the season, but it was seedless. All our experiments show that *Cucurbita pepo* and *C. maxima* do not hybridize."

(3) *Impotency of individual pollinations.*—"In pumpkins and squashes the flowers are either wholly staminate or wholly pistillate, and they can not, therefore, pollinate themselves. But the two kinds of flowers are borne upon the same plant. Pollination between two flowers upon the same plant I have termed individual pollination, in distinction from close pollination, or pollination of the flower by itself, and from cross-pollination, or pollination between flowers on different plants."

Experiments are cited from which it appears "that in squashes and pumpkins the pollen is impotent upon pistils on the same plant, and that true inbreeding does not occur in them. The experiment will be extended to all varieties."

(4) *Do cucumbers spoil musk-melons?*—The experiments thus far made indicate that melons and cucumbers do not cross.

(5) *Progression of flowers.*—A tabulated record is given of the number and time of appearance of the staminate and pistillate flowers as observed daily from July 29 to September 29, 1890, on two musk-melons, one water-melon, and one cucumber plant. The totals were as follows:

	Musk melons. No. 1	Musk melons. No. 2.	Water melons	Cucurbits.
Staminate flowers	670	316	211	807
Pistillate flowers	28	53	23	54

The figures are full of significance. They show that the staminate, or male flowers are more numerous in each case than the pistillate or fertile flowers, ranging from six to twenty-four times as many. They show that the pistillate flowers make their appearance later in the season—from 5 days in the cucumber to 30 days in one of the musk-melons. They also show that, as a rule, the staminate flowers continue to appear later in the fall than the pistillate. Musk-melon No. 1 was a weaker plant than the others, and it began to fail by the middle of September. It is, therefore, instructive to observe that in this plant the proportion of pistillate flowers was the smallest, and that they appeared later and ceased earlier than the other plants. And the figures illustrate the common observation that the cucumber is more precocious than the melons. The figures show forcibly the necessity of starting melons early in our short seasons.

North Carolina Station, Bulletin No. 73*b* (Meteorological Bulletins Nos. 13 and 14), December, 1890 (pp. 36).

METEOROLOGICAL SUMMARY FOR NORTH CAROLINA, H. B. BATTLE, PH. D., AND C. F. VON HERRMANN (pp. 3-31).—Notes on the weather and tabulated summaries of meteorological observations by the North Carolina weather service, co-operating with the United States Signal Service, for October and November, 1890. The bulletins are illustrated with maps of North Carolina showing the isothermal lines and the total precipitation for different parts of the State.

Origin of cold waves, C. F. Von Herrmann (pp. 32–36).—A short discussion of the causes for the origin and progress of cold waves, with brief descriptions of attendant phenomena.

Oregon Station, Bulletin No. 7, October, 1890 (pp. 12).

Comparative tests of small fruits and vegetables, G. Coote.—Tabulated notes on 21 varieties of tomatoes, 21 of strawberries, and 13 of peas, with brief descriptive notes on 4 varieties of cauliflowers.

South Dakota Station, Third Annual Report, 1890 (pp. 23).

Report of director L. McLouth, Ph. D. (pp. 7–10).—This is for the year ending June 30, 1890, and includes a brief outline of the work of the station and a financial report.

Department of agriculture, L. Foster, M. S. A. (pp. 11–15).—Brief reference is made to experiments with sugar-beets, recorded in Bulletin No. 16 of the station (See Experiment Station Record, Vol. II, p. 130), and with methods of seeding wheat, recorded in Bulletin No. 17 (See Experiment Station Record, Vol. II, p. 132).

Experiments with grasses and clovers have been made at the station for three seasons under conditions making a severe test of their ability to endure drought and the cold of snowless winters. Details are to be reported in a future bulletin of the station. Some of the results are stated to be as follows:

(1) In seeding the best stand came from sowing done early in the spring, not in connection with grain, the grass being allowed to grow the whole season unmowed.

(2) Of the plats with grain, that sown with winter rye proved best, the rye being planted in the fall and the grass in the spring.

(3) Twenty eight plats were sown with different varieties of grasses and clovers in the spring of 1888. Of these the following are all that have survived the two seasons with little or no loss by drought or winter-killing: tall meadow oat, wood fescue, Kentucky blue-grass, meadow fescue, creeping bent, redtop, sheep's fescue, orchard grass, Rhode Island bent, hard fescue, and timothy. Alfalfa sown one year earlier, lived through two winters, was mowed three times each season, the first excepted, and was still vigorous when plowed under at the close of the third season. A large per cent of the following clovers, sown in mixture with several of the above-named grasses, have lived through the two winters even under the test of close pasturing the second season: common red, mammoth red, alsike, white Dutch, and alfalfa.

Experiments with corn with reference to the length of the season of growth at the station as well as to test varieties and methods of planting and cultivation, have given results stated as follows:

(1) The season is sufficiently long for the complete maturity of nearly all the flints and most of the small dents.

(2) The season can not be lengthened by planting before the temperature of the soil and atmosphere are right for growth.

(3) Thorough preparation of the soil before planting and early cultivation before and immediately after the corn is up are the surest and most economic methods of clearing the field of weeds. Frequent shallow cultivation throughout the first half of the season gives the most favorable conditions for full growth and maturity, and fosters the moisture in the soil for the use of the plant.

(4) The varieties of corn that have proved best in the station tests are as follows: *Flints*—Landreth's Extra Early, King Philip, Early Canada, Yellow Smut Nose, Chadwick, Blue Blade, Self-Husking, Pride of Dakota; *Dents*—Lovelands, Hughson's, Gold Coin, Davis's White, and Dakota King. All the above varieties, planted at different intervals in May, have matured with us by the 12th day of September.

The potato crop is already an important one in South Dakota, the soil being well adapted to the growth of this vegetable. Experiments with varieties and methods of planting and cultivation have been made at the station. Early planting has uniformly given the largest yield of merchantable potatoes.

"The best variety of early potatoes tried by the station is the Vanguard; then follow in the order named Early Harvest, Early Ohio, and Chicago Market. For the main crop Polaris excels, but is closely followed by Beauty of Hebron, Hughson's Rose, Thorburn, Warner's Rural Blush, and Snowflake."

The cross-breeding of Shropshire and Merino sheep has been successfully tried, the cross retaining in great measure the fleece of the Merino and the size, "mutton quality," fecundity, and hardiness of the Shropshire.

DEPARTMENT OF FORESTRY, HORTICULTURE, AND BOTANY, C. A. KEFFER (pp. 16, 17).—A brief outline of work in these lines at the station. Last spring between 5 and 6 acres were added to the forest plantation. The varieties used were the silver maple (*Acer dasycarpum*), box-elder (*Negundo aceroides*), white elm (*Ulmus americana*), green ash (*Fraxinus viridis*), a Russian poplar (*Populus certinensis*), shell-bark hickory (*Carya alba*), and bitter hickory (*Carya amara*). An acre and a half was planted to forest-tree seeds of many varieties, including several species of oak, walnut, butternut, hickory, elm, ash, maple, cherry, sycamore, bass-wood, wild plum, and others. A plat of about half an acre was planted with Scotch pines, and additions were made to the evergreen nurseries.

Collections of the native grasses and noxious weeds of the State are being made.

DEPARTMENT OF CHEMISTRY, J. H. SHEPARD, M. A. (pp. 18, 19).—A brief statement of the analyses made during the year.

DEPARTMENT OF ENTOMOLOGY, I. H. ORCUTT, M. D. (pp. 20–23).—A brief account of work in this department of the station, especially investigations on cut-worms.

Tennessee Station, Second Annual Report, 1889 (pp. 16).

This includes a brief account of the history, organization, and equipment of the station; abstracts of four bulletins issued in 1889; and outlines of work during 1889 in field and feeding experiments, chemistry, botany, horticulture, and entomology.

Texas Station, Second Annual Report, 1889 (pp. 117).

REPORT OF DIRECTOR F. A. GULLEY, M. S. (pp. 9, 10).—A brief outline of the work of the station.

REPORT OF AGRICULTURIST, G. W. CURTIS, M. S. A. (pp. 11–16).—This includes brief notes on experiments with fertilizers on corn, varieties of cotton, Johnson grass, and germination tests with wheat.

Fertilizers for corn (pp. 11–13).—This is a report of progress in an experiment conducted on the poorest quality of shallow upland "post-oak" soil, with a subsoil of stiff and almost impervious clay. The objects are: "(1) to show the comparative value of the different fertilizers used for corn; (2) to see how long the effect of the fertilizer will be noticeable; (3) to find whether it is practicable, on the class of soil used in the test, to save labor in applying the fertilizers by putting on at one application as much as would ordinarily be used in three or four successive applications; (4) to note the exact cost of the increase in each year's crop and the gain or loss per acre in each case."

The fertilizers used were cow manure, Texas phosphate, bone meal, ammoniated phosphate, and cotton-seed meal. The results for each of 5 years (1885–1889) are stated in tables.

> The bone meal has produced the largest yield each year except the fifth (1889), when it was exceeded by the ammoniated phosphate. For the first 5 years the value of increased production places the fertilizers used in the following order: bone meal, cow manure, Texas phosphate, ammoniated phosphate, cotton seed meal. On the other hand, comparing with reference to net profit, by deducting the cost from the value of increase, we have cow manure, ammoniated phosphate, cotton-seed meal, Texas phosphate, bone meal. * * *
>
> It is a matter of considerable interest that the effect of each fertilizer has been shown in more marked degree with each succeeding year; how long it will continue is a question for further trial. The indications now seem to point to a possible economy of labor with soil of this description in making heavier applications of manure at longer intervals.

Cotton, test of varieties (pp. 13, 14).—Brief notes on a test in 1889 of Hefley's Gold Leaf and Cherry's Long Staple. Both are considered valuable varieties and the test will be continued.

Experiment with Johnson grass (pp. 14, 15).—This is a continuation of an experiment reported in the Annual Report of the station for 1888. Its objects are "(1) to increase the stand on poor land in order to make it a profitable hay crop; and (2) to find some effective means of complete destruction, which should be cheap enough for practicability. The first we are certainly accomplishing by manuring the land

and by turning under each year the late growth of grass the last of November or the first of December."

For the destruction of the grass "the recommendation noted in the Annual Report for 1888 still holds good, viz.: Turn over the grass field in midsummer, leaving the root stocks exposed, dry, to the sun. We have found that this kills on our land about 50 to 60 per cent. Next, as soon as the scattering bunches appear after the first treatment, turn the soil over again without harrowing. We have found this kills 15 to 25 per cent more. In other words, the stand can be destroyed on land of the character used in the test, by two or perhaps three plowings, beginning in midsummer." The straggling bunches which remain may be destroyed with salt or chloride of lime. These, however, destroy other vegetation and "may cause bare spots for a series of years."

Germination tests with wheat (pp. 15, 16).—A brief note on a field test of damaged wheat sent by the Minnesota Station, in order that the test might be made before the time for the spring sowing in Minnesota.

REPORT OF HORTICULTURIST, T. L. BRUNK, B. S. (pp. 17–53).—A reprint of Bulletin No. 8 of the station (See Experiment Station Record, Vol. I, p. 319).

REPORT OF VETERINARIAN, M. FRANCIS, D. V. M. (pp. 55–60).—A brief account of the Southern cattle-plague and its treatment, with notes on joint experiments by the Texas and Missouri Stations.

COTTON ROOT ROT, L. H. PAMMEL, B. AGR. (pp. 61–92, illustrated).—A reprint of Bulletin No. 7 of the station (See Experiment Station Record, Vol. I, p. 318).

REPORT OF CHEMIST, H. H. HARRINGTON, M. S. (pp. 93–105).—This includes a record of analyses of soils and alkali incrustations and waters of the Rio Grande Valley, waters and soils from other parts of Texas, iron ores, coal, manure from cattle fed on cotton-seed hulls and meal, the melting point and volatile acids of butter from cows fed on cotton-seed hulls and meal, silage, and sugar bagasse.

FEEDING EXPERIMENT, F. A. GULLEY, M. S. (pp. 107–114).—A summary of Bulletin No. 6 of the station (See Experiment Station Record, Vol. I, p. 152).

REPORT OF METEOROLOGIST, D. ADRIANCE (p. 115).—A monthly summary of observations made during 1889.

Utah Station, First Annual Report, 1890 (pp. 13).

HISTORY OF THE ORGANIZATION OF THE STATION (pp. 5–10).—This includes the text of the act of Congress of March 2, 1887; extracts from the Territorial law establishing the station; and brief statements regarding the organization and progress of the station.

REPORT OF DIRECTOR, J. W. SANBORN, B. S. (pp. 10–13).—Brief statements regarding the farm, buildings, experimental work, and first two bulletins of the station.

Utah Station, Bulletin No. 3, January, 1891 (pp. 8).

EXPERIMENTS WITH GARDEN VEGETABLES, E. S. RICHMAN, B. S.—Brief notes on 14 varieties of peas, 10 of radishes, 2 of lettuce, 7 of cabbages, 6 of cauliflowers, 3 of beets, 4 of sweet-corn, 2 of asparagus, 4 of squashes, 4 of cucumbers, 7 of water-melons, and 5 of musk-melons.

Utah Station, Bulletin No. 4, January, 1891 (pp. 21).

DYNAMOMETER TESTS WITH WAGONS, J. W. SANBORN, B. S.—Accounts are given of tests with reference to the draft of wagons as affected by the distribution of the load, the height of the wheel, the length of hitch, loose *vs.* tight burrs, lubricants, style of construction of the wagon, different kinds of roads, and different grades. The following summary is taken from the bulletin:

(1) When the load was placed over the hind wheels it drew 10 per cent easier than when it was placed over the front wheels.

(2) The hind wheels drew 23.3 per cent easier over an obstacle 3 inches high than the front wheels. This was when attachment of the force was directly applied to each set of wheels.

(3) The hind wheels when drawn over an obstacle by the usual hitch drew only 1.2 per cent easier than the fore wheels.

(4) When the ends of the wagon were reversed and the draft was applied directly to the hind wheels it drew nearly 5 per cent easier.

(5) The incline of the reach towards the front wheels, as now put in, causes the wagon to draw harder than it should.

(6) Lowering the reach or the point of application of force on the hind wheels materially decreases the draft; therefore the reach should run horizontally or on an upward incline from the rear to the front wheels.

(7) Higher front wheels will reduce draft.

(8) The change of the angle of draft as applied from the end of the pole, varied the draft very markedly and the relation of the draft of the front to the rear wheels.

(9) A long hitch or such a hitch as occurs when lead horses are used, increases draft on account of the angle of the hitch.

(10) Loose burrs with one half or more inches play lessen the draft of the load by 4.5 per cent.

(11) Little difference was found between the draft of three wagons.

(12) Draft varied with the varieties of grease used, from nothing to 17 per cent—lard proving the best or practically the same as a manufactured axle grease and but a little better than cylinder oil.

(13) The draft of varying roads and condition of roads varied very markedly, being between the best and the poorest classes of local roads nearly 300 per cent in difference. In this trial neither the best nor the poorest roads were available—only such as are found in country towns. * * *

(14) There is a decided opportunity for improvement of our wagons.

Vermont Station, Bulletin No. 22, October, 1890 (pp. 8).

TESTS OF DAIRY COWS; HOME VS. FAIR GROUNDS, J. L. HILLS, B. S. (pp. 75-82).—This is an account of tests made of the milk of six cows exhibited at the Champlain Valley Association Fair, at Burlington, in 1890.

For the purpose of studying "the effect of the disturbing influence of a change from quiet pasture to crowded fair grounds upon the animal system, as shown by the milk pail," the milk given by each cow in one day previous to her removal to the fair grounds, and in 24 hours while at the fair, was weighed and analyzed (gravimetrically). The results are as follows:

Total yields of milk and milk constituents.

	Milk yield.	Total solids	Fat.	Casein.	Milk, sugar, and ash.
	Pounds	*Ounces*	*Ounces.*	*Ounces.*	*Ounces.*
No. 1, Ayrshire.					
At home, September 2	26.50	61 70	19 18	18.40	24.12
At fair, September 4	31 00	78 21	33.10	17,23	27.88
More (+) or less (—) than at fair	−4.50	—16 51	—13.92	+1 17	−3.76
No. 2, Jersey:					
At home, September 2	23.06	52.60	18.41	13.14	21.05
At fair, September 4	24.44	58.34	21 99	14.17	22.19
More (+) or less (—) than at fair	—1 38	5 74	—3.57	—1.03	—1.14
No. 3, Jersey:					
At home, September 2	28.75	60.94	19.63	14.81	26.50
At fair, September 4	23.13	50 56	16.28	11.97	22.31
More (+) or less (—) than at fair	+5.62	+10.38	+3.35	+2 84	+4.19
No. 4, Jersey:					
At home, September 2	32.75	67 66	23 41	14 10	30.16
At fair, September 4	33.07	62 48	19 32	14.02	29 14
More (+) or less (—) than at fair	—0 32	+5.18	+4 09	+0 08	+1.02
No. 5, Ayrshire:					
At home, September 2	20 31	43.37	14.07	10.13	19 17
At fair, September 4	17 07	37 54	13 75	8 23	15.55
More (+) or less (—) than at fair	+3.24	+5.83	+0.32	+1 90	+3.62
No. 6, Holstein					
At home, September 2	18.94	38.01	11.95	9.03	17.03
At fair, September 4	18.63	37.31	12 19	8.75	16 37
More (+) or less (—) than at fair	+0.31	+0.70	0.24	+0.28	+0.66

The sudden increase [in the case of No. 1] from 19.2 to 33.1 ounces butter fat in 24 hours on removal from home to strange and disquieting surroundings was most unexpected, but is fully authenticated. * * *

To summarize the results obtained, the effects of worry and confusion on the system of cows as shown in the milk flow, appear conflicting, depending upon individuality. Some cows produced more at home amid their usual surroundings, while some seemed stimulated by excitement and nervousness, and made a better showing at the fair grounds than they did at home. The data at hand seem to indicate that the tendency of nervous excitement is to lessen quantity of milk ingredients, and to variously effect quality according to the individuality of the animal, the fat being the most variable ingredient. In the light of such results it may be well to consider whether the true "butter test" of a cow should be made under the circumstances attending a great fair, or at home among natural surroundings and away from unnatural excitements.

In addition to the above data, the amount and composition of the milk given during 24 hours at the fair grounds, data relative to skimming and churning, and the score of points are given for 3 of the cows which were competing for prizes.

Virginia Station, Annual Report, 1890 (pp. 15).

This is for the year ending June 30, 1890, and contains the reports of the director, treasurer, botanist and entomologist, chemist, and agriculturist. These reports include brief outlines of the work pursued at the station.

West Virginia Station, Bulletins Nos. 8, 9, and 10, June, July, and August, 1890 (pp. 20, 8, and 6).

SUMMARY OF METEOROLOGICAL OBSERVATIONS AND REPORTS OF CORRESPONDENTS ON THE CONDITION OF AGRICULTURE IN THE STATE, J. A. MYERS, PH. D. (pp. 226-258).—Reports of correspondents in different parts of the State on the weather, crops, live stock, etc., for April, May, June, July and August, 1890. There are also summaries of the meteorological observations at the station from October 10, 1888, to June 1, 1889; from March 1 to June 30, 1890; and for the months of July and August, 1890.

West Virginia Station, Special Bulletin (pp. 48).

POTASH AND PAYING CROPS (illustrated).—A reprint of a compilation prepared by the German Kali Works.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

DIVISION OF STATISTICS.

REPORT No. 81 (NEW SERIES), JANUARY AND FEBRUARY, 1891 (pp. 56).—This includes articles on the number and value of farm animals in the United States; cotton returns for February, 1891; the canning industry in 1890; the Angora goat in California; new railroad construction in 1890; European crop report for February, 1891; notes on foreign agriculture; and transportation rates for January and February, 1891.

The number of horses on farms, as reported, is 14,056,750. Average price of all ages, $67, a decline from last year of $1.84.

The number of mules is 2,296,532, having an average value of $77.88, a decline from last year of 37 cents.

The number of milch cows is 16,019,591, an increase of 66,708 from last year. The average value per head is $21.62, which is less by 52 cents than last year's average. There is a tendency to increase of dairying in the South, especially in the mountain region, which offers inducements of cheap lands and abundant grasses.

Other cattle aggregate 36,875,648, including those on ranches. The highest value is $28.64 in Connecticut; the lowest $8.46 in Arkansas. In Texas the average value is $8.89.

The estimated number of sheep is $43,431,136; the average value, $2.51, or an increase of 24 cents, or more than 10 per cent. All other kinds of farm animals have declined slightly in price. A tendency to increase of numbers is seen in most of the States, though the heavy losses from the severe winter of last year on the Pacific slope have decreased the aggregate.

The aggregate number of swine is 50,625,106, showing a decline of nearly 2 per cent. The average value is $4.15, a decrease of 57 cents per head. The scarcity of corn caused a slaughter of stock hogs in poor condition, tending to glut the market and reduce the price temporarily.

BUREAU OF ANIMAL INDUSTRY.

SPECIAL REPORT ON THE DISEASES OF THE HORSE, 1890 (pp. 556, illustrated).—This was prepared under the direction of Dr. D. E. Salmon, Chief of the Bureau, by a number of the most eminent members of the veterinary profession in the United States, and is intended to be a safe and scientific guide to farmers in the treatment of their horses. While the different topics have been treated in a more or less popular style, the volume contains valuable contributions to existing knowledge, and

will doubtless be of great service to professional veterinarians as well as to farmers. The report is illustrated with 44 plates, 11 of which are colored.

The general topics treated in the separate articles are as follows: Methods of administering medicines, C. B. Michener, V. S.; Diseases of the digestive organs, C. B. Michener, V. S.; Diseases of the urinary organs, James Law, F. R. C. V. S.; Diseases of the respiratory organs, W. H. Harbaugh, V. S.; Diseases of the generative organs, James Law, F. R. C. V. S.; Diseases of the nervous system, M. R. Trumbower, V. S.; Diseases of the heart and blood vessels, M. R. Trumbower, V. S.; Diseases of the eye, James Law, F. R. C. V. S.; Lameness, A. Liautard, M. D., V. S.; Diseases of the fetlock, ankle, and foot, A. A. Holcombe, D. V. S.; Diseases of the skin, James Law, F. R. C. V. S.; Wounds and their treatment, C. B. Michener, V. S.; General diseases, Rush Shippen Huidekoper, M. D., Vet.; Shoeing, William Dickson, V. S.

CENTRAL EXPERIMENTAL FARM OF CANADA.

Bulletin No. 8, January, 1891 (pp. 11).

RESULTS OF EARLY AND LATE SEEDING OF BARLEY, SPRING WHEAT, WILLIAM SAUNDERS.—During the season of 1890, 36 tenth-acre plats of light, sandy loam "were devoted to a test of the relative advantages of early, medium, and late sowing of barley, oats, and spring wheat, two varieties of each grain being sown" on six different dates from April 22 to May 28, at intervals of one week. The varieties selected were, *barley*—Prize Prolific and Danish Chevalier (both two-rowed sorts); *oats*—Prize Cluster and Early Race Horse; *spring wheat*—Red Fife and Ladoga. At the first sowing, however, Anglo-Canadian wheat was used instead of Early Race Horse oats. The results, as stated in a table, uniformly and strongly favored the early seeding. The bulletin also contains tabulated notes on the growth of the several varieties and the extent to which they suffered from rust.

Bulletin No. 9, February, 1891 (pp. 34).

RESULTS OF THE GROWTH OF TWO ROWED BARLEY FROM SEED IMPORTED BY THE GOVERNMENT OF CANADA, WILLIAM SAUNDERS.—In the spring of 1890, 10,000 bushels of Prize Prolific barley, a two-rowed variety, which had been tested with good results in Canada, were imported by the Canadian Government. More than half of this amount was sold to 2,600 Canadian farmers. Of these, 1,052 have sent in reports of the crop produced and samples of the grain, as follows.

Results of tests of two-rowed barley (Prize Prolific) imported by the Government of Canada for seed.

	Number of reports, with samples.	Yield per acre.	Total yield from 112 pounds.	Weight per bushel as received.	Weight per bushel after cleaning.
		Bushels.	*Bushels.*	*Pounds.*	*Pounds.*
Ontario	872	25⅛	28⅓	50¼	51⅛
Quebec	48	20¾	22¾	48¼	50⅜
Nova Scotia	13	26⅛	20½	47 1/16	48
New Brunswick	23	22¼	24 1/11	47⅜	49⅜
Prince Edward Island	11	26⅛	27⅛	48	49
Manitoba	62	39	43¾	48	50⅜
Northwest Territories	22	27½	32 1/11	46⅛	50⅛
British Columbia	1	45¾	45¾	50⅛	53

Out of the 872 reports received from Ontario, 337 report a yield of the crop after roots, and the average of these is 27¾ bushels per acre; and the samples sent weighed as they were received 50½ pounds per bushel [and after cleaning 51½ pounds per bushel]. * * *

The results of those grown after other crops, given in 535 reports, are as follows: yield, 24½ bushels per acre; weight as received, 50¾ pounds; after cleaning, 51½ pounds. The average of the barley crop of Ontario for 1890, as given by the Bureau of Statistics, is 22.2 bushels per acre, and this is based on the returns from 1,015 correspondents. On comparing the yield of two-rowed barley with this estimate, the barley grown after roots shows an average gain of 5½ bushels per acre, and that grown after other crops of over 2 bushels; or, taking the average of the whole, the yield is 25½ bushels, or a gain of 3.3 bushels. Such a gain per acre on the barley acreage of Ontario for 1890 would add $1,157,187 to the income of the farming community of the province and still better results might be looked for with early sowing.

A table gives the average acreage in barley, yield per acre, and the total yields for 8 years (1882–89) in each county of Ontario. The totals for the province are: acreage, 772,245; yield per acre in bushels, 26.2; total yield in bushels, 20,218,930. "Last year (1890) the acreage fell off to 701,326 acres, and the yield was 4 bushels less than the average of the previous 8 years, which brought the total yield down to 15,600,169."

Summaries are given of the reports received in 1890 from 320 farmers in Ontario on the tests of the imported seed of the two-rowed barley.

This list might have been greatly increased with similar testimony equally good, but enough has been given to show that there is not much fault to be found with the barley. A proportion of the reports are less favorable than some of those which have been given, but in most instances these may be attributed to a very wet season, lack of drainage, or want of care in the preparation of the land. Many think that the straw is a little weak, but a very wet season does not afford a good opportunity for correct judgment on this point. There is no doubt that two-rowed barley takes a longer time to mature than the six-rowed, and that it should be sown early. * * *

It has been stated that the two-rowed barley grown in this country deteriorates so rapidly as to become deficient in vitality. To test the validity of this statement the germinating power of 685 samples of last year's growth in Ontario has been determined, and the average is 94½ per cent.; 29 samples from Quebec averaged 92 per cent.; 17 from New Brunswick, 87½ per cent.; 7 from Prince Edward Island, 96½ per cent.; 27 from Manitoba, 88 per cent.; and 13 from the Northwest Territories, 88½ per cent., making a total of 778 samples tested.

Samples of the barley grown in 1890 have been sent to England "to have its market value determined, also its quality for malting and brewing." A brewery test is also to be made in Canada.

The importance of early seeding and thorough preparation of the soil before sowing is urged, as well as the desirability of thoroughly cleaning the grain before it is put on the market.

ABSTRACTS OF REPORTS OF EUROPEAN INVESTIGATIONS.

Official methods of analysis adopted by the Association of Agricultural Experiment Stations in the German Empire,* September 18 and 19, 1890 (*Landw. Versuchs Stationen*, 38, *pp.* 281–313).

ARTIFICIAL FERTILIZERS.

Preparation of the sample.—The sample is to be screened and well mixed; in the case of moist materials the screening may be omitted. As soon as received the sample is to be weighed and divided into two parts, one to be used for analysis and the other to be preserved in a tight jar in a cool place for three months. In crude phosphate and bone-black the moisture is to be determined at 105–110° C.; and in samples which may lose ammonia during drying, the ammonia is also to be determined. Where an analysis is to be controlled by another chemist, the sample, at least 250–500 grams, is to be sent in a tightly closed jar, accompanied by a statement of its weight. With substances liable to lose water by grinding the moisture is to be determined in both the coarse and the ground material, and the results of analysis calculated for the moisture of the unground (original) material.

Fertilizers containing phosphoric acid.—The solution of the soluble phosphoric acid is to be made by shaking 20 grams of superphosphate in a liter flask with 800 c. c. water during 30 minutes, filling with water to the liter mark, and filtering. The use of a shaking machine making one hundred and fifty revolutions per minute is recommended. (This regulation goes into effect January 1, 1891.) The solution containing double superphosphate is to be heated with nitric acid (10 c. c. conc. HNO_3, sp. gr. 1.4, to 25 c. c. of the superphosphate solution) to change any pyrophosphoric to tribasic acid. In control analyses the molybdate method is to be employed. In estimating iron and alumina in raw phosphates the Glaser method is recommended. According to this method 5 grams of phosphate are dissolved in 25 c. c. nitric acid of 1.2 specific gravity and 12.5 c. c. hydrochloric acid of 1.12 specific gravity, the solution made to 500 c. c., filtered, and to 100 c. c. of the filtrate (= 1 gram of substance) in a 250 c. c. flask, 25 c. c. sulphuric acid of 1.84 specific gravity added. After standing about 5 minutes, the contents of the flask are shaken, 100 c. c. of 95 per cent alcohol added,

*See Experiment Station Record, Vol. I, p. 175.

the flask cooled, filled to the quarter-liter mark with alcohol, and the solution shaken, in which operation concentration takes place. The flask is again filled to the mark with alcohol, the solution shaken, and filtered after half an hour. One hundred c. c. of the filtrate (= 0.4 grams substance) are heated in a platinum dish until the alcohol is evaporated, and the alcohol-free solution heated to boiling in a beaker with 50 c. c. water. Ammonia is added until the solution is alkaline (but not during boiling), the excess of ammonia driven off by heat, the solution cooled and filtered, the filter washed with warm water, and the remaining phosphates of iron and alumina ignited and weighed. Half of the weight is assumed to be $Fe_2O_3+Al_2O_3$. The operation requires 1½ to 2 hours.

For determining the fineness of Thomas slag, 50 grams of slag are to be shaken in a sieve not less than 20 cm. in diameter, made of wire cloth, No. 100, Amandus Kahl, Hamburg.

The loss by heating 10 grams of superphosphate for 3 hours at 100° C. is taken as representing moisture.

In estimating the total phosphoric acid in bone meal, fish guano, animal fertilizers, crude phosphates, and superphosphates, 5 grams of the sample are to be dissolved in 50 c. c. *aqua regia* composed of 3 parts HCl sp. gr. 1.12 and 1 part HNO_3 sp. gr. 1.25, or heated for one half hour with 20 c. c. HNO_3 sp. gr. 1.42 and 50 c. c. H_2SO_4 sp. gr. 1.8.

Fertilizers containing nitrogen.—The nitrogen in blood, ground meat, and similar organic materials may be determined according to the Kjeldahl, or the soda-lime method. For determining the nitrogen as nitrate in mixtures, the method of Schlösing, Grandeau, or Lunge may be used, and the total nitrogen determined according to the Kjeldahl-Jodlbauer method or a similar one. This latter method is to be used in case of Peruvian guano. With saltpeter a direct method is to be used. The total nitrogen in commercial ammonia salts is to be estimated by distilling with sodium hydrate solution.

ANALYSIS OF FEEDING STUFFS.

Fat.—Ether, free from alcohol and water, is to be used in fat determinations; the extraction is to be complete, and the weighed ether extract must be soluble without residue in water-free ether. It is recommended to make studies of the amount of free acids in the ether extract as obtained by hot and cold extraction. For this the acids are to be dissolved in alcohol, the solution neutralized with normal soda solution as given by Fresenius, using phenolphthalein as indicator, and the results calculated for oleic acid (1 c. c. tenth-normal soda solution = 0.0282 grams oleic acid). A study of the value of the iodine number in fodder analysis is also recommended.

The relative money values for protein, fat, and carbohydrates were fixed for the present at 3 : 2 : 1.

To secure a better knowledge of the individual constituents of the more important commercial feeding stuffs, one, two, or three separate articles have been assigned to each of a large number of specialists for thorough investigation. Investigations of the constituents of over fifty of the more important by-products in the manufacture of flour, starch, sugar, beer, liquors, and volatile and fatty oils used for feeding are thus provided for.

The desirability of guarantees of composition in the sale of feeding stuffs was discussed, and steps were taken toward promoting it.

The adulteration of feeding stuffs and the injurious effects arising from the same were discussed, and the importance of veterinary assistance was urged.

SOIL ANALYSIS.

Sampling.—In behalf of the committee of the association on this subject, which had met in August, 1890, Professor v. Wolff, of Hohenheim, presented a report, on the basis of which the following recommendations were adopted: A soil is to be sampled by taking, according to the size of the field, 3, 5, 9, 12, or more samples in different places at like distances from one another. These samples are each to represent a vertical section of the soil to the depth to which it is plowed, or, for examination of the subsoil, to a depth of 60 to 90 cm. (24 to 35 inches). The different samples are to be examined separately, or, in case it is only required to know the average of the whole field, they are mixed thoroughly and an average sample examined.

Mechanical analysis.—The sieves recommended are as follows: (1) Gauze sieve No. 16, Erhardt & Metzger, Darmstadt; meshes, 0.09 mm. square or 0.11 mm. diagonally. (2) Brass-wire sieve No. 100, Kahl, Hamburg; meshes, 0.14–0.17 mm. square, or 0.45–0.50 mm. diagonally. (3) Brass-wire sieve No. 50, Kahl, Hamburg; meshes, 0.35–0.39 mm. square or 0.45–0.50 mm. diagonally. (4) Punctured brass sieves with holes 1.2 and 3 mm. in diameter. Five hundred grams of soil are to be mixed in a porcelain dish with about 1 liter of water, and heated on a water bath, with frequent stirring, for about 2 hours or until the sample is thoroughly macerated. The sample is then mechanically analyzed by washing through the different sieves placed under water, using a brush for stirring the soil in the sieve. The amount left on each sieve is dried and weighed. The amount passing sieve 1, dust and clay, may be further analyzed by the Wagner modification of the Kühn separating cylinders, obtainable from Erhardt & Metzger, Darmstadt.

Chemical analysis.—That part of the untreated sample which passes the 3-mm. sieve (dry screening) is taken for chemical analysis. The mineralogical character of the coarser particles is to be determined as far as possible. The determinations ordinarily required are those

of water, loss by ignition, nitrogen, humus, and the constituents of the extract prepared by (*a*) digesting one weight part of soil and two volume parts of 25 per cent HCl (taking account of the $CaCO_3$ in the soil) at ordinary temperature for 48 hours with frequent stirring, or (*b*) digesting one weight part of soil and two volume parts of 10 per cent HCl (taking account of the $CaCO_3$ in the soil) on a water bath for 3 hours, with frequent stirring. All results are to be calculated for water-free soil. In estimating the loss by igniting, the soil is dried at 140° C, ignited, moistened with $(NH_4)_2CO_3$, and gently ignited again. This method is not allowable with moor soil or soil very rich in humus. The humus is determined according to the method of Dr. Loges (*Landw. Versuchs-Stationen*, 28, *p.* 229), by evaporating the soil with phosphoric acid to remove the carbonates, and then igniting with copper oxide.*

The proper rates for fees for analyses made by the stations were also discussed, and the commission on this subject was directed to inquire into the actual cost of making the analyses, as a basis for establishing a minimum tariff.

In view of the need, which is coming to be strongly felt by the stations, of assistants better educated in applied chemistry, a commission was appointed to consider this matter and to confer with the proper authorities regarding it.

Studies in artificial digestion of albuminoids, A. Stutzer (*Landw. Versuchs-Stationen*, 38, *pp.* 257–279).

The action of certain organic acids in the digestion of albuminoids.—It is a familiar fact that lactic, butyric, acetic, malic, tartaric, and citric acids occur in the stomach, being either formed there during the digestive process or introduced with the food consumed. Without doubt these organic acids play an important part in digestion, and the object of the author was to find out whether they are capable of taking the place of hydrochloric acid in the digestion of albuminoids, and if so, to what extent. As a matter of theoretical interest the action of formic and propionic acids was also studied. The amount of albuminoid nitrogen dissolved by 50 c. c. of pepsin solution, only slightly acid, from cotton-seed meal containing 100 mg. of nitrogen in the form of digestible albuminoids, was taken as the basis for the comparison. On this basis studies were made of the increased amount of nitrogen dissolved by the same quantity of pepsin solution when there was added to it (*a*) HCl sufficient to give the total solution a normal content of 0.05, 0.1, or 0.2 per cent HCl; and (*b*) organic acids equivalent (by titration with baryta water, using phenolphthalein) to the HCl added. The 50 c. c. of pepsin solution contained 0.05 grams, or 0.01 per cent of HCl (it being impossible to prepare the solution without this acid), and 25.685 grams of nitrogen. The acids used were found to be free from nitrogen.

*See Fresenius Quantitive Analysis, 6th (German) Edition, p. 675.

1.5323 grams of finely ground cotton-seed meal containing 100 mg. of nitrogen soluble in pepsin solution and 3.03 mg. of nitrogen in form of amides were taken for each trial. The digestive solution was in each case allowed to act on the meal at 40° C. during 30 minutes. From the total nitrogen dissolved was subtracted the sum of the nitrogen in the pepsin solution used, the amide nitrogen in the cotton-seed meal, and the amount of nitrogen found by test to be dissolved by the pepsin solution without the addition of the acid. The excess of nitrogen dissolved was assumed to be due to the action of the acid in each case, and was taken as the relative measure of that action. The relative action due to added acids, when the amount added was equivalent to 0.1 per cent HCl, was calculated from the separate trials to be as follows:

Hydrochloric acid	62	Lactic acid	39
Formic acid	30	Malic acid	33
Acetic acid	7	Tartaric acid	31
Propionic acid	1	Citric acid	27
Butyric acid	7		

According to these figures lactic, malic, tartaric, citric, and formic acids possess a high value in the digestion of albuminoids. The figures for acetic acid were surprisingly low and those for formic acid unexpectedly high.

The action of common salt in digestion.—It is known that in the digestive process common salt (NaCl) causes a liberal secretion of gastric juice, accelerates the diffusion of the liquids, and in this way aids digestion. These experiments were made to determine whether acid pepsin solution containing salt would dissolve a larger amount of albuminoids than a like quantity of pepsin without salt, and if this proved to be the case, whether the salt had a specific action on the pepsin, or on the HCl, or on both. Tests were made of the amount of nitrogen dissolved from 1.5323 grams of finely ground cotton-seed meal (containing 100 mg. pepsin-soluble nitrogen) in 30 minutes at 40° C., by each of the following agents:

(1) Water.
(2) Water + NaCl, three different solutions (0.25. 0.5, and 1 per cent NaCl).
(3) Water + HCl, three different solutions (0.05, 0.1, and 0.2 per cent HCl).
(4) Water + NaCl + HCl, nine different solutions (NaCl 0.25, 0.5, and 1 per cent, with HCl 0.05, 0.1, and 0.2 per cent).
(5) Acid pepsin solution, 50 c. c., + HCl, three different solutions (0.05, 0.1, and 0.2 HCl).
(6) Acid pepsin solution, 50 c. c., + NaCl + HCl, nine different solutions (NaCl 0.25, 0.5, and 1 per cent, with HCl, 0.05, 0.1, and 0.2 per cent).

This plan of experiment showed the specific action of salt and hydrochloric acid, each alone; of hydrochloric acid and pepsin together, of each in connection with NaCl; and of the three combined. In estimating the action, allowance was made for the nitrogen in the pepsin and in amides, as already described.

The conclusions from the experiments were as follows:

(1) Common salt alone dissolves the albuminoids of cotton-seed meal to a very small extent only. Cotton-seed meal was therefore a favorable material for the investigation.

(2) The amount of nitrogen dissolved by 0.05 per cent hydrochloric acid is greatly increased by the addition of NaCl. Thus, the addition of 0.25 per cent NaCl to the 0.05 per cent HCl solution increased the relative amount dissolved from 7 to 41. With 0.1 per cent HCl the increase from the addition of minute quantities of NaCl was small, and with the addition of 1 per cent NaCl the solvent action was diminished. With 0.2 per cent HCl, small quantities of NaCl increased the action of the acid (increase from 53 to 71, with 0.25 per cent NaCl), but 1 per cent NaCl diminished the action of the acid. In other words, in HCl (without pepsin) the larger the amount of salt added the smaller was the increase in the amount of nitrogen dissolved, and when more than 1 per cent NaCl was added the amount dissolved was less than by 0.1 per cent HCl solution alone.

(3) With pepsin the case is very different. More albuminoids were dissolved by acid pepsin with 1 per cent of NaCl than by that containing 0.25 or 0.5 per cent NaCl.

(4) NaCl increases the solvent action of the acid pepsin solution, more albuminoids having been dissolved in every case with than without it. The action was the most favorable when in addition to the salt 0.05 or 0.1 per cent HCl was present, and the most unfavorable when 0.2 per cent HCl was present. The author believes that these experiments indicate anew the high value of common salt in digestion, especially where the acid content of the mucous membrane of the stomach is below the normal.

Changes in the digestibility of albuminoids caused by the heating of foods and feeding stuffs.—It was formerly believed that the steaming of feeding stuffs increased the digestibility of the protein. It has been proved in digestion experiments on animals that this is not the case,* and that with wheat bran the higher the temperature and the longer the steaming is continued, the more indigestible the albuminoid materials become.

The author's object was to determine whether this change in the digestibility of protein could be detected by means of experiments with artificial digestion outside of the animal, and in particular whether the method of approximating the value of albuminoids recently proposed by him is† sufficiently sensitive to show such fine differences in the digestibility. In experiments made some 8 years ago, but not published, the author found that when egg albumen, palm cake, cocoa bean, and

* Landw. Jahrbücher, 1879, p. 933; Landw. Versuchs-Stationen, 29, pp. 214.

† Landw. Versuchs-Stationen, 37, p. 132. The details are given of a method by which the amount of nitrogen dissolved from 100 milligrams of nitrogen in form of pepsin-soluble albuminoids by 0.05, 0.1, and 0.2 per cent HCl, both with and without pepsin, is determined.

ground meat were heated above 100° C. the digestibility of the albuminoids decreased in proportion to the height to which the temperature was raised.

The following experiments were made at temperatures between 90 and 100° C.

1. *Wheat bran.*—When 2 grams of wheat bran were treated with one fourth of a liter of acid pepsin solution for 36 hours, HCl being gradually added till the solution contained 1 per cent HCl, the albuminoids remaining undigested were found to be equal to 0.308 per cent nitrogen.

When, previous to the digestion experiment, the bran was heated in 100 c. c. of boiling water for one fourth of an hour, or heated in a dry state at 98° C. for 6 hours, or when mixed with water, dried, and then heated at 98° C. for 48 hours, the percentage of nitrogen in the undigested residue remained the same as where the bran received no previous treatment (0.308 per cent nitrogen). Likewise when 2 grams of bran were treated with 400 c. c. acid pepsin solution containing 0.2 per cent HCl during 36 hours, without increasing the amount of HCl, the undigested albuminoids contained, as before, 0.308 per cent nitrogen.

Two series of experiments were made with bran in which determinations were made of the amounts of albuminoid nitrogen dissolved by water, by dilute hydrochloric acid, and by acid pepsin solution, after the bran had been subjected to different preparatory treatment; 6.25 grams of bran, containing 100 mg. of pepsin-soluble nitrogen, were used for each test. In the first series of experiments the bran was heated in 100 c. c. of boiling water for some minutes, allowed to cool to 40° C., the solvent added at the same temperature, and allowed to act 1 hour. In the second series the dry bran was heated for 8 hours at 97–99° C., 100 c. c. water at 40° C. (saturated with chloroform to prevent decomposition of the bran) added, and on the following day treated with the solvent for 30 minutes. The results indicated that the amount of albuminoid nitrogen soluble in water was not decreased by heating the bran in boiling water. HCl without pepsin dissolved very little more albuminoid nitrogen from the cooked bran than water alone, but acted somewhat more strongly on the heated bran. The author states that these observations seem to corroborate views previously expressed by him,* that wheat bran contains a ferment which in the presence of HCl acts similarly to pepsin, but which is destroyed by the action of heat. The amount of albuminoid nitrogen dissolved by pepsin solution was considerably decreased by the heating; and the author believes, from other experiments, that the action of boiling water in this direction is much more rapid than that of dry heat.

2. *Bread and flour of cereals.*—Experiments similar to those described above were made with wheat flour and with bread made from a mixture of rye and wheat meals. The conclusions were as follows:

* Landw. Versuchs-Stationen, 37, p. 117.

(1) The digestibility of the nitrogenous materials is considerably decreased by the baking process. The nitrogenous materials of the crust are more difficult of digestion than those of the "crumb," or interior portion.

(2) HCl without pepsin dissolves the nitrogenous substances of flour to a very considerable degree, but is almost without action on those of baked bread.

(3) Water alone dissolves about four times as much of albuminoid materials from flour as from a like amount of bread.

3. *Pea nut cake.*—The previous experiments were made with materials rich in carbohydrates and relatively poor in fat and protein. To test the action of a material containing more protein and fat, experiments were made with pea-nut cake. Previous to the digestion trials, the cake was in some instances heated either in ordinary air, in dry air, or in dry carbon dioxide at 90–97° C., and in others in boiling water. The result of these trials led to the following conclusions:

(1) The albuminoids contained in pea-nut cake are rendered difficultly soluble in water by the action of either moist or dry heat.

(2) Very dilute hydrochloric acid (0.05 per cent) has very little solvent action on the albuminoids after the pea-nut cake has been cooked in water. Dry heat made little if any change in their solubility in HCl.

(3) The albuminoids were less soluble in acid pepsin solution after being subjected to dry heat or cooked in water than before this treatment.

The above experiments all go to show that the albuminoids of vegetable substances are rendered less digestible by dry heating and by cooking in water.

Does the presence of small quantities of fat or oils in foods retard the digestion of the albuminoid materials?—It is well known that large quantities of fat impregnating a food may mechanically hinder the digestion of the albuminoid materials, and the object of the author was to ascertain if the quantities contained in ordinary oil cakes are sufficient to present such mechanical hindrance. The experiments were made on cotton seed meal containing 9 per cent fat, and cocoanut cake containing 15 per cent fat. Samples of these materials in their original condition (before the extraction of the fat), and after the fat had been extracted by ether, were treated with water alone, with water containing 0.05, 0.1, and 0.2 per cent HCl, and with pepsin solution containing the same percentages of HCl, the amount of substance taken for each test being such as to furnish 100 mg. of pepsin-soluble albuminoid nitrogen.

The results indicated that the fat presented a slight hindrance to the action of water and of HCl, but the difference between the amounts of albuminoid nitrogen dissolved by acid pepsin solution from the material treated with ether and that in the original state were so small as to be within the allowable error of analysis. The author regards it, there-

fore, as fair to conclude that in the case of these two materials the fat ordinarily present does not render the albuminoid materials less digestible.

Action of amides and ammonium salts in the animal economy.—A summary, by H. Weiske (*Journ. f. Landw.*, 38 (1890), *p.* 137) —Many vegetable materials used as food for herbivorous animals contain amide bodies, prominent among which is asparagin. Feeding experiments by Weiske* showed that when asparagin was added to a ration rich in carbohydrates and poor in albuminoids, it acted as an albuminoid economizer, that is, took the place of a certain amount of albuminoids in nourishing the body. Thus, sheep which on a ration of hay, starch, and sugar stored in the body respectively 0.27 and 0.279 grams of nitrogen each per day, stored 1.38 and 1.948 grams of nitrogen when asparagin was added to the feed, and 2.427 and 1.668 grams when the asparagin was replaced by peas furnishing an equal amount of nitrogen in the feed. In experiments with goats, there was no falling off in either the quantity or quality of the milk or in the live weight of the animal when a part of the albuminoids of the feed were replaced by asparagin, but when carbohydrates were fed in place of the asparagin, changes were at once noticeable. M. Schrodt† obtained similar results in experiments with milch cows.

From experiments with rabbits N. Zuntz and P. Bahlmann‡ found asparagin capable of economizing the albuminoids, and J. Potthaft§ concluded that asparagin is a true nutrient, which by its combustion in the organism saves the material of the body from consumption.

In experiments by F. Röhmann‖ on the formation of glycogen, rabbits were fed a ration poor in albuminoids but rich in carbohydrates, to which asparagin, glycin, ammonia salts, etc., were added. The animals which received these materials in addition to the regular ration formed considerably more glycogen than those fed carbohydrates alone; and the action of asparagin, glycin, and ammonia salts was about equal in this respect. Röhmann suggested that since asparagin breaks up in the animal organism, forming ammonia, and since the above experiments have shown that ammonia salts act in the same manner as asparagin in the formation of glycogen, it is, therefore, safe to conclude that in the metabolism ammonia salts possess the same action in economizing the albuminoids that asparagin does.

The author (H. Weiske) doubts this economic action of ammonia salts, as numerous experiments have shown that the feeding of ammonia salts is accompanied by a decided increase in the breaking down of the albuminoid bodies, and have never indicated that the salts economized the consumption of the albuminoids in the nutrition of the animal.

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* Zeitsch. f. Biologie, Bd. 15, pp. 261–296; and Bd. 17, pp. 413–500.

† Mittheil. d. land- u. milchwirtschaftlichen Versuchs-Station in Kiel, Heft 7, 1883.

‡ Verhandlungen d. physiolog. Gesellschaft zu Berlin vom 7 Juli, 1882.

§ Archiv. f. d. gesammte Physiologie, Bd. 32, p. 280.

‖ *Ibid.*, Bd. 39, p. 21.

It has been also shown that when glycogen, sarkosin, benzamid, tyrosin, taurin, etc., were fed the breaking down of the albuminoid materials of the body increased in a marked degree, and that these substances do not possess the economic action attributed to asparagin.

Experiments by the author and B. Schulze* in which amido-succinic acid (aspartic acid), and amido-succinamic acid were each added to the food showed that like quantities of these two amide bodies do not produce like effects; in other words, that the action is dependent upon whether the amide group (NH_2) is contained in the radical or in the carboxyl.

Is the action of ammonium salts similar to that of asparagin when fed with a ration deficient in albuminoids and rich in carbohydrates? H. Weiske and E. Flechsig (*Journ. f. Landw.*, 38 (1890), *pp.* 137–149).—To further test this question a normal, adult sheep, weighing about 110 pounds, was fed from June 15 to July 15, 600 grams of hay, 250 grams of starch, 50 grams of cane sugar, and 8 grams of salt per day; that is, a ration deficient in albuminoids, but rich in carbohydrates. June 30 and July 1 and 2 in addition to the regular food the animal received daily 500 c. c. of a solution of ammonium carbonate and ammonium acetate, containing 4.7 grams of nitrogen, which were fed by means of a funnel and rubber tube. The animal remained during these 3 days in an entirely normal state, except that on the third day it did not consume its food quite as readily. The ammonia was then dropped and the feeding resumed as before. The average amount of nitrogen contained in the excreta for 5 days previous to feeding ammonium salts was 3.05 grams per day; June 30 the excreta contained 4.42 grams of nitrogen; July 1, 6.74 grams; July 2, 6.98 grams; July 3, 4.28 grams, and until July 12 the amount of nitrogen excreted daily was larger than that previous to the feeding of the salts. After this the average was 3.01 grams of nitrogen per day, or nearly the same as before the ammonia salts were added to the feed. From June 30 to July 11 the total amount of nitrogen given off was 49.33 grams. If the amount of nitrogen fed in the ammonium salts (3 x 4.7=14.10 grams) be subtracted from the total amount of nitrogen given off from June 30 to July 11 (49.33 grams), the remainder (35.23 grams) gives an average daily excretion of 2.94 grams of nitrogen, nearly the same amount as that excreted previous to the feeding of the ammonium salts, indicating that these salts all passed off in the excreta instead of serving as nutriment to the animal. The quantities of sulphur given off also go to show that there were no albuminoids laid on the body in consequence of the nitrogen fed in the form of ammonium salts. The authors conclude that ammonium salts do not act as albuminoid economizers in the way in which asparagin does; and that this action peculiar to asparagin is, therefore, not due merely to the formation of ammonia from it within the organism.

*Zeitsch. f. Physiologie, Bd. 20, p. 277.

Dry vs. wet food for swine, Krauss (*Zeitsch. d. landw. Ver. f. Rheinpreussen; Deutsche Molkerei-Zeitung*, 1891, *No.* 9, *p.* 119).—It was formerly believed that the moistening of the food given was desirable, and experiments have been made in Germany* to compare the effects of the same feeds when fed in a dry state and when moistened or made into a soup.

The experiment here described was made with four pigs of the same litter, and continued from November 28, 1889, to March 8, 1890. The food during this time consisted of beets and potatoes in like amounts, creamery refuse, swill, and rye and barley meal. At the beginning about 1½ pounds each of the rye and barley meals were fed per head; later this was increased to 2 pounds. The pigs were fed three times a day. Two received the grain (rye and barley meals) mixed with the other food (wet f od), and the other two received it separately (dry food) after the other food had been eaten clean.

The gains in live weight during 130 days of feeding were as follows:

Dry fodder.		Wet fodder.	
Pigs.	Weight.*	Pigs.	Weight
	Pounds		*Pounds*
No 1.....	118	No. 3.....	100
No. 2	115	No 4	76
Total ..	233	Total .	176

* The German pound is about 1.1 English pounds

There was, then, a difference of 57 pounds in favor of the pigs to which the grain was fed dry.

The sterilization of milk by peroxide of hydrogen, Heidenhain (*Centralblt. f. Bakteriologie u. Parasitenkunde*, 1890, *No.* 16, *p.* 448, and *No.* 22, *p.* 695; *Deutsche Molkerei-Zeitung*, 1891, *No.* 9, *p.* 122).—If hydrogen peroxide be shaken with milk and then allowed to stand, a viscous, yellowish froth separates, and after 12 to 24 hours a thin, clear layer of liquid appears underneath this layer of froth, the rest of the liquid remaining white and milky and becoming slightly acid in its reaction. The froth contains large numbers of different bacteria and micrococci. The clear layer below contains only a few bacteria, and the milky remainder is free from them. Culture experiments by the author seemed to indicate that the bacteria contained in the upper layer were dead. No butter could be churned from milk or cream treated with the peroxide. The acid reaction in the main portion is not due to lactic acid, but to the peroxide. An addition of 10 per cent of peroxide of hydrogen to cooked milk is said to render it permanently sterile; uncooked milk is preserved by the same amount for from 3 to 8 days. During the first few days in particular the milk remains perfectly palatable.

* Among others, those reported in Fühling's landw. Zeitung, 1885, p. 585; *Ibid.* 1890, p. 440; Deutsche landw. Presse, 1886, No. 71; and Wochensch. d. Pomm. ökon. Gesellsch., 1887, No. 5.

Detection of margarine in butter (*Deutsche Molkerei Zeitung*, 1891, *No.* 9, *p.* 120).—According to the method of Bochairy (*Pharmazeutische Zeitung*, 1890, *p.* 518), 15 c. c. of clarified fat are dissolved in a graduated glass cylinder, with 15 c. c. tolnol, and 50 c. c. absolute alcohol added. The solution is then heated to 50° C. and well shaken. If the fat consists to a considerable extent of margarine the solution at once becomes cloudy; in case of mixtures this cloudiness or precipitation shows itself first when the solution is cooled to 40° C. A butter mixture containing 10 per cent margarine gave a precipitate occupying 10 c. c., but no constant relation was found between the percentage of margarine and the volume of the precipitate.

According to R. Brullé (*Compt. rend.*, 112 (1891), *p.* 105), a 25-per cent solution of silver nitrate in 95 per cent alcohol gives characteristic colors with the different oils, and is applicable for the detection of margarine in butter; 12 c. c. of the filtered fat and 5 c. c. of the silver solution are mixed in a test tube, the tube is dipped in boiling water, and the change of color observed. Pure butter gives no color with the re-agent, but a mixture of margarine and butter gives a brick-red color. The color is very pronounced with butter containing 10 per cent of margarine, but some practice is required to detect less than 5 per cent.

Examination of butter with the oleofractometer (*Deutsche Molkerei-Zeitung*, 1891, *No.* 9, *p.* 120).—Jean (*Bull. Soc. Chim.*, 1890, *p.* 105) recommends the use of the oleofractometer as constructed by himself and Amagat. The instrument is adjusted by means of a normal oil at 45° C., and the examination of samples of butter is made at the same temperature. According to his observations the refraction for pure butter is —35°, while that for pure margarine is —15°.

Viollette* gives the index of refraction for butter as varying from —33° to —28°, and that for margarine from —15° to —8°.

Depaire (*Rev. intern. des Falsific.*, 1890. 4, *p.* 65) found the refraction of numerous samples of butter made during winter and summer to vary between —35° and —39°, and that of different kinds of margarine between —9° and —17°. Mixtures of pure natural butter (index 38°) and oleomargarine (index 10°) in different proportions showed the following refractions:

Per cent of margarine	0	10	20	30	40	50	60	70	80	100
Index of refraction	38°	36°	34°	31°	29°	26°	21°	18°	15°	10°

The presence, although not the nature, of a foreign fat in butter would, according to these experiments, seem to be indicated with considerable certainty by the Jean-Amagat oleofractometer.

Detection of cocoanut butter in cows' butter, F. Jean (*Monit. Scient.*, 1890, 4, *ser.* 4, 1116; *Deutsche Molkerei-Zeitung*, 1891, *No.* 9, *p.* 121).—Pure cocoanut butter, the manufacture of which is said to be on the increase, closely resembles butter made from cows' milk. Unlike other vege-

* See Experiment Station Record, Vol. II, p. 465.

table oils, it contains very nearly the same proportion of soluble fatty acids as cows' butter, and this characteristic which distinguishes cows' butter from the other animal fats can not, therefore, be relied upon here. According to the author acetic acid furnishes a means for recognizing the presence of cocoanut butter. He finds that the oils and fats, under conditions not stated, differ in the amount of acetic acid which they are capable of dissolving, as is shown by the following:

Examinations of pure butter, cocoanut butter, mixtures of the two, and oleomargarine.

	Refraction in oleo fracto-meter.	Acetic acid dissolved.	Melting point of the fatty acids	Soda solution* per 5 grams of fat.		
				Soluble acids.	Volatile acids.	Non-volatile acids.
	Degrees	*Per cent*	*Degrees.*	*C. C.*	*C. C.*	*C. C.*
Pure butter	— 30	63 33	38	37-22	29-26	87–88
Cocoanut butter	— 59	over 100	27	29 30	7 8	83.75
Crude oleomargarine	— 17	26 66	26-37	2	0.8– 0 9	95
Pure butter	— 30	63.33	37 8	34.29	30 26	87.3
The same, + 10 per cent cocoanut butter	— 33	66.66	37	....	26 8	....
The same, + 15 per cent cocoanut butter	— 34	90	....	....	....	....
The same, + 20 per cent cocoanut butter	— 36	96	....	....	24.13	....

*Strength of soda solution not given

The oleofractometer, the acetic acid test, and the determination of the volatile acids seem, then, to be first in importance in the detection of adulteration with cocoanut butter.

Koch's lymph as a means of diagnosing cases of tuberculosis in cattle (*Deutsche Molkerei-Zeitung*, 1891, *pp.* 81–83, and *p.* 116).—Several trials have been recently made to test the application of the lymph discovered by Dr. Robert Koch of Berlin, in the diagnosing of cases of tuberculosis in cattle.

Under the direction of W. Gutmann (Veterinary Institute, Dorpat, Russia; *Balt. Woch. f. Landw. Gewcberfl. u. Handel*), three cows known to be tuberculous were inoculated behind the shoulder blade, A with 0.1, B with 0.2, and C with 0.3 c. c. of lymph. The general reaction following the inoculation of persons infected with tuberculosis consists, according to Dr. Koch, of an attack of fever, beginning usually 4 or 5 hours after inoculation, during which the temperature of the body rises to 39°, 40°, and in some cases to 41° C. (102.2°, 104°, or 105.8° Fah.).

The temperature of the animals was taken on the day before inoculation once in 2 hours, and on the day of inoculation and the following day every hour. There was an increase in the temperature of each cow, commencing approximately 11 hours after the inoculation, and lasting with A (0.1 c. c. of lymph) 4 hours, with B (0.2 c. c.) 9 hours, and with C (0.3 c. c.) 10 hours. A's temperature rose to 40°, B's to 40.8°, and C's to 41.7° C. Three and a half days after the first inoculation the inoculation of A was repeated, with 0.3 c. c. of lymph. The reaction came

as before, after 11 to 12 hours, and lasted about 4 hours, but the temperature rose only to 39.6° C., or less than that following the first inoculation where 0.1 c. c. was used. This latter agrees with the observations of Dr. Koch, who explains the fact by the presence of more living tuberculous tissue at the beginning, so that a smaller amount of lymph suffices to produce a stronger reaction than later; through the injection a small amount of the tissue capable of producing the reaction is used up, and proportionally increasing doses are necessary to produce the same degree of the reaction afterwards.

As a control over the above experiment two healthy steers were inoculated each with 0.3 c. c. of lymph. Careful observations every hour revealed no increase in the temperature of the body. The animals were slaughtered after 24 hours and the organs found to be all in a normal, healthy condition.

Experiments were made at the Veterinary School, in Berlin, by Roeckl and Schütz (*Veröffentlichungen d. k. Gesundheitsamt*, 1891, *No.* 5) with two cows suspected of being tuberculous, and a healthy heifer. The temperature, pulse, and general condition were closely observed for several days prior to and following the inoculation. The animals were all inoculated at the same time, each with 0.5 c. c. of lymph diluted with 4.5 c. c. of a one half per cent solution of carbolic acid in water.

The fever reaction appeared in both the suspected cows after about 11 hours. The body temperature of one cow ranging from 38.8° to 39° rose to 40.3° C., and that of the other ranging from 38.1° to 38.7° rose to 40.9° C. When slaughtered both cows were found to be infected. No apparent reaction followed the inoculation of the heifer believed to be healthy, and when slaughtered she was found to be in a healthy condition.

Anton Sticker, a veterinary surgeon in Cologne, reports (*Arch. f. animalische Nahrungsmittelkunde*, 1891, *No.* 4) a trial in which four cows, thought to be tuberculous, were each inoculated with 0.1 c. c. lymph. The fever reaction came in one after 7 hours, in the others after 9 hours. One cow was slaughtered and found to be tuberculous.

EXPERIMENT STATION NOTES.

CALIFORNIA STATION.—The investigation of the oil yield, etc., of the different olive varieties thus far grown in California is being continued with interesting results, soon to be published. Analyses of different varieties of oranges are being made and the work will be continued through the orange season. Eight varieties of olives and 47 of wine grapes were received from Italy in February. Nearly all these varieties are new to California and will be propagated for distribution at the central station during the present season. Tests of 5 varieties of sugar-beets grown at the foot-hill substation last season and harvested the first week in February, show a peculiar habit of growth, but a very satisfactory percentage of sugar, even on the slopes of the Sierra Nevada Range, thus materially extending the possible area of cultivation.

IOWA STATION.—C. F. Curtiss, B. S. A., has been elected assistant director; L. H. Pammel, B. Agr., botanist; and H. Osborn, M. S., entomologist.

KENTUCKY COLLEGE AND STATION.—The station building was burned February 23. The chemical laboratories of the station and college were completely destroyed, together with the libraries and apparatus of the professors of agriculture and botany. The station library and records were saved. The laboratory records of digestion experiments and analysis of milk from six cows, from September last, were destroyed. The loss to the station will reach $5,000 and to the college about $3,000. There was no insurance on the apparatus, but the building was insured for $10,000.

The grain louse (*Siphonophora avenæ*) has been successfully followed through the winter at this station. Specimens taken from corn blades and ears in midsummer were transferred to growing wheat and kept under cover until the succeeding spring. Other specimens secured later in the season on volunteer oats and wheat were also kept under cover through the winter in young wheat on blue grass (*Poa pratensis*). During all this time the confined aphides continued to reproduce ovo-viviparously. The mild winter weather which prevailed in 1889-90, afforded an opportunity to follow the species out of doors all winter, and the observations indicate that the species can and does sometimes reproduce throughout the winter without the production of sexual individuals.

MICHIGAN STATION.—Feeding experiments with steers have recently been completed and the results will soon be published in a bulletin.

MINNESOTA STATION.—In consequence of a fire which destroyed the office building in October, 1890, and burned up bulletins Nos. 1-12 of the station, it will be impracticable for the station to furnish applicants with copies of bulletins earlier than No. 13.

MISSOURI STATION.—Owing to changes in the management of the station during 1889 no report for that year will be issued.

NEW MEXICO COLLEGE AND STATION.—C. H. T. Townsend, of the Division of Entomology of the United States Department of Agriculture, has been elected professor of entomology in the college and entomologist to the station. A. J. Wiechardt, M. E., of the Iowa Agricultural College, has been elected professor of mechanical engineering in the New Mexico Agricultural College. The college and station are now occupying a building recently erected for their joint use.

OREGON STATION.—The station is collecting statistics regarding the methods of pig feeding employed in the State, with a view to conducting experiments in pig feeding.

SOUTH CAROLINA STATION.—In view of the transfer of the station no detailed report of the operations of the station during 1890 will be issued. A report on field tests at Spartanburg and Darlington will be published with the aid of funds furnished by the State board of agriculture.

CENSUS BULLETIN.—Census Bulletin No. 38, March 10, 1891 (pp. 11), contains the statistics of grape growing and wine production in the United States, collated by H. Gardner. The total area devoted to grape growing in 1889 was 401,261 acres, of which 307,575 acres were in bearing. The total product was 572,139 tons, of which 267,271 tons were sold for table use and 301,868 tons were sold to wineries, at which 24,306,905 gallons of wine were made. In California 41,166 tons were used in 1889 in making 1,372,195 boxes (20 pounds) of raisins and 23,252 tons for dried grapes and miscellaneous purposes. The product of 1890 in that State is estimated at 16,500,000 gallons of wine and 2,197,463 boxes of raisins, with young raisin vineyards enough to raise the yield within the next five years to 8,000,000 or 10,000,000 boxes.

The grape industry in the United States in 1889 represented a total value in land, improvements, machinery, and appurtenances of $155,661,150, and furnished employment to 200,780 persons. More than one half the plant and workers were in California and one fifth in New York and Ohio.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

MARCH 1 TO APRIL 1, 1891.

DIVISION OF CHEMISTRY:

Bulletin No. 28.—Proceedings of the Seventh Annual Convention of the Association of Official Agricultural Chemists.

Farmers' Bulletin No. 3.—Culture of the Sugar-Beet.

DIVISION OF VEGETABLE PATHOLOGY:

Farmers' Bulletin No. 4.—Fungous Diseases of the Grape and Their Treatment.

DIVISION OF STATISTICS:

Report No. 82 (new series), March, 1891.—Report on Distribution and Consumption of Corn and Wheat.

Album of Agricultural Graphics.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

MARCH 1 TO APRIL 1, 1891.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Bulletin No. 21 (new series), December, 1890.—A New Root-Rot Disease of Cotton; Report of Alabama Weather Service.

Bulletin No. 22 (new series), January, 1891.—Experiments with Cotton; Report of Alabama Weather Service.

CANEBRAKE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 11, February, 1891.—Experiments with Cotton.

Third Annual Report, 1890.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ARIZONA:

Bulletin No. 1, December 1, 1890.—Organization of the Station.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF CALIFORNIA:

Bulletin No. 91, February 28, 1891.—Port and Sherry Grapes in California; Importation of Italian Grapes; Importation of Olives.

COLORADO AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 14, January, 1891.—Sugar-Beets.

GEORGIA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 10, December, 1890.—Fertilizer and Culture Experiments on Corn; Variety Tests of Corn.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF ILLINOIS:

Bulletin No. 13, February, 1891.—Field Experiments with Corn; Garden Experiments with Sweet Corn.

Bulletin No. 14, February, 1891.—Milk Tests.

Bulletin No. 15, February, 1891.—The Fruit Bark Beetle; Experiments with Grass Seeds and with Grasses and Clovers; Use of Fungicides upon the Apple, Potato, and Grape.

AGRICULTURAL EXPERIMENT STATION OF INDIANA:

Second Annual Report, 1889.

Third Annual Report, 1890.

KANSAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 14, December, 1890.—Winter Protection of Peach Trees; Notes on Grapes.

Bulletin No. 15, December, 1890.—Experiments and Observations on Oat Smut, Made in 1890.

KENTUCKY AGRICULTURAL EXPERIMENT STATION:

First Annual Report, 1888.

LOUISIANA AGRICULTURAL EXPERIMENT STATIONS:

Bulletin No. 6 (second series).—Results of Field Experiments with Sugar-Cane.

Bulletin No. 7 (second series).—Annual Report of State Station, 1890.

LOUISIANA AGRICULTURAL EXPERIMENT STATIONS—Continued.

Bulletin No. 8 (second series).—Results of 1890 Obtained at the North Louisiana Experiment Station.

Bulletin No. 9 (second series).—Sugar-Cane Borer and its Parasite.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meteorological Bulletin No. 26, February, 1891.

Third Annual Report, 1890.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:

Bulletin No. 71, February, 1891.—Beet Sugar.

Bulletin No. 72, February, 1891.—Six Worst Weeds.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF MINNESOTA:

Bulletin No. 15, February, 1891.—Wheat, A Comparison of Foreign and Native Varieties; The Selection and Changing of Seed, Etc.

MISSOURI AGRICULTURAL COLLEGE EXPERIMENT STATION:

Bulletin No. 13, January, 1891.—Reports on Spraying for the Codling Moth, Apple Scab, and Black Rot of the Grape; Reports on Strawberries, Raspberries, Tomatoes, Peas, and Potatoes; List of New Fruits Received for Testing.

NEW YORK AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 26 (new series), January, 1891.—New York State Fertilizer Control and Fertilizer Analyses; Outline of the History of Commercial Fertilizers; General Principles Underlying the Use of Fertilizers.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 73, October 15, 1890.—The Best Agricultural Grasses.

Bulletin No. 74*a*, December 31, 1890.—Meteorological Summary for North Carolina, December, 1890.

OREGON EXPERIMENT STATION:

Annual Report, 1890.

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 20, January, 1891.—Forestry.

VIRGINIA AGRICULTURAL AND MECHANICAL COLLEGE EXPERIMENT STATION:

Bulletin No. 8, January, 1891.—Potato Tests.

Bulletin No. 9, February, 1891.—Tomatoes.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF WISCONSIN:

Bulletin No. 26, January, 1891.—Sugar-Beet Culture in Wisconsin.

DOMINION OF CANADA.

DEPARTMENT OF AGRICULTURE:

Central Experimental Farm, Bulletin No. 9, February, 1891.—Results of Growth of Two-Rowed Barley from Seed Imported by the Government of Canada.

Central Experimental Farm, Special Bulletin.—The Establishment of Cheese Factories and Creameries.

GUELPH AGRICULTURAL COLLEGE:

Bulletin No. 55, December 2, 1890.—Experiments in Swine Feeding with Grain and Meal.

EXPERIMENT STATION RECORD.

Vol. 2. MAY, 1891. No. 10.

EDITORIAL NOTES.

A not uncommon idea of an experiment station is that of a good-sized farm, of which a considerable portion is divided into experimental fields for testing the effects of tillage, the action of manures, and the growth of crops, while the rest is used to raise fodder for animals under experiment. There are really three views as to the proper function of the experiment station farm. One, which may be called the "model farm" idea, makes it a means for demonstrating to the public the ways in which farming may be properly and successfully carried on. A second, rightfully rejecting the first as opposed to the true purpose of an institution for experimental inquiry, makes the farm the chief instrument for that inquiry and regards the laboratory and the greenhouse as more or less important accessories. A third view, and the one to which experience has very uniformly led, recognizes the facts that the station is useful in proportion as it discovers the laws that underlie the right practice of farming; that to find out these laws requires abstract research, such as is best made in the laboratory, the greenhouse, and the experimental stable; and that the farm instead of being the chief feature of the station, should in nearly all cases be only one of the accessories.

In some quarters there is the disposition to revive the idea that an experiment station should be very largely a model or at least an experimental farm. The argument is that in order to reach the practical results which the farmer needs, the work of the station must conform closely to the conditions which exist on the ordinary farm; that the processes of the laboratory and the experimental plat do not take into account the peculiar conditions which the practical farmer has to meet in the raising of his crops and the management of his stock; and that therefore the station must conduct its experiments on a scale sufficiently large to make sure that its methods will meet the test of actual farm practice; in other words, that the station should make farming on a somewhat extensive scale a prominent feature of its operations. But

the difficulty is that ordinary farm experiments are affected by such a variety of conditions and those conditions are so incapable of measurement or control that the results can not as a rule be generally applied until the same experiment has been repeated many times and in many different places. There are, indeed, cases which justify large use of the farm and of practical farm methods, and very often one of the best ways for the station to extend its influence and usefulness is by instituting farm experiments in different places. But as a general rule the experimenting that is most widely and permanently useful is not that in which the station farm is the principal factor.

The history of the experimental farm idea is interesting, and one notable feature is the way it repeats itself. It commonly begins with the impression just referred to. The farm is secured; a laboratory is perhaps added. The plats are laid out and the crops selected for experiment; different methods of planting, tillage, and manuring are tried; seeds of different plants are tested side by side; cattle, sheep, or swine are purchased and fed on this or that diet and the results noted. Faithful, intelligent work is done; results of value are obtained; but they do not have the practical value that was anticipated. Gradually the experimental work gravitates to the laboratory, the plant house, the experimental stall, and the respiration apparatus. More or less land is reserved for tests of one sort or another, but in most cases the use of the farm for farm purposes is practically given up. And when it comes to starting a new station, if the promoters have had experience they do not usually make much outlay for land except for what is needed to build upon.

The first of the European stations, that at Möckern in Saxony, was established with this idea and located on a farm donated for its use. Its first work was largely on the farm, with methods akin to the best farm practice, but later it was narrowed to experiments for which only a small stable connected with the chemical laboratory was required. The station is now one of the best equipped in Europe; it makes little use of the land, but has elaborate laboratory facilities, including a respiration apparatus.

The largest station in Europe is that at Halle, in Prussia. It is controlled by an agricultural society, and was located for years on a farm in the little village of Salzmünde, about eight miles outside the city. The farm was noted for its size and the pecuniary success of its management. The proprietor was keenly interested in the experiment station movement and offered many facilities for the work of the station upon his farm. But gradually it became apparent that the work could be done better in Halle, and the station was moved to the city and brought into connection with the university. The station at Weende, where Henneberg and his assistants for many years carried on their famous experiments, was likewise on a farm, but experience showed that a more intimate connection with the university at Göttingen was

desirable, and the station was moved to the city, located in the Agricultural Institute of the university, and the farm is but little used. The chief station of Bavaria is in the center of the city of Munich and connected with the Agricultural Department of the Royal Polytechnic School. The station at Ida Marienhütte, after the experience of a number of years, was transferred to the city of Breslau and united with the university. The station at Hohenheim, of which Wolff has for many years been the director, is connected with the well-known agricultural school at that place, but does not make use of any considerable amount of land for experimental purposes.

The experiment station of Messrs. Lawes and Gilbert in England, of which Americans hear more than of any other European station, is located in the country, and on the farm of Sir John Lawes, by whom it is supported. But it has a laboratory, and the experimental work which has been done outside the laboratory has been mostly in a few narrow lines—wherein the wisdom of its management is manifested—and the whole amount of land under experiment is only a comparatively few acres.

While there are numerous instances in which European stations have been begun on farms in the country and afterwards removed to the city, generally to be brought into connection with a school or university, it would be difficult to find a case in which the work has gravitated away from the city and the school to the country and the farm. And it is to be remembered that the policy of these stations is that of the farmers, who see that it serves their interests. Nearly every one of the stations just cited is to a greater or less extent under the control of the agricultural societies and receives at least a part of its pecuniary support from them.

The development of the station enterprise in this country, and especially in the newer States, does not admit of our rigidly following the policy of European stations in respect to farm experiments. In Europe, and to a somewhat less extent in the older regions of the United States, the practical experience of intelligent agriculture has solved many of the more general problems. In a large part of our country, however, this experience is lacking, and the experiment stations must help to supply it. The farm thus becomes a more important adjunct to the station. But our stations are wise in extending their field experiments beyond the station farms, and in planning investigations which can be carried out under station direction by competent men on their own farms in different regions. Experience, however, is enforcing the importance of providing that the co-operative experiments be under direct and adequate supervision by trained experimenters.

While the peculiar and varied conditions under which our stations are working admit of a wider use of farm experiments than is deemed advisable in Europe, we must not forget the fact, which experience teaches and on which authorities on agricultural investigation at home

and abroad are substantially agreed, that the bulk of the best work of an experiment station is to be done not in the field but in the laboratory, the greenhouse, and the stable. The chief reason for this lies in the fact that in order to obtain definite results of value in agricultural researches, as in other lines of experimental inquiry, the experimenter must be able to control the conditions of his investigations; otherwise it is impossible for him to discover the real cause of any results which he may obtain or to know that these results are anything more than mere accidents. Agriculture in this respect is on the same footing with medicine. The investigator in medical science works in his laboratory and dissecting room with the microscope, chemicals, animals, and cadavers. He isolates the bacteria, inoculates the guinea-pig, and tries this drug or that course of treatment on the lower animal. Only after he believes that by these means he has traced the disease to its cause and has discovered a remedy which can be safely used for the human subject does he begin the treatment of men. Even then he is very careful in the selection of his patients and carries on his experiments in well-equipped hospitals, where he has all the appliances which science has devised for the comfort and relief of the diseased, as well as the assistance of trained nurses and skilled helpers. He calls in physicians of experience to watch the progress of the cases undergoing the new treatment, and takes advantage of their criticisms and suggestions. After months or years of the most painstaking research and experimenting the new remedy or treatment, if successful, is published for the use of the ordinary practitioner. But even then the intelligent physician knows very well that the conditions of the average sick-room or the individual peculiarities of the patient require the exercise of the nicest judgment in adapting the methods of the laboratory and the hospital to the requirements of the actual practice of medicine.

It would be absurd to reverse the order of these processes: to consider first the individual patient and wait for the investigation of the causes of a disease until some doctor had by good luck hit upon a remedy with which he had cured a dozen patients. Yet this is exactly what the advocates of farm experiments as the chief business of experiment stations would undertake to do. They would do the best they could in a few fields with varying soils, drainage, rain-fall, and sunshine, with exposure to all the vicissitudes of the season, whose deceptive influences the farmer so well knows, in the hope that in some lucky hour they may find a new method which can be widely applied to farm practice. This is the empirical as distinguished from the scientific method, the method of the Middle Ages as compared with that of the nineteenth century. It is because agriculture has been so slow to appreciate the benefits of scientific investigation that it has made such relatively slow progress. The arts, which, like surgery and mechanics, have taken the most complete advantage of the discoveries of the laboratory, have advanced at an astonishing pace. The discoveries with which Pasteur

and Koch have so profoundly agitated the medical world have come as the definite result of the most abstract researches into the causes of disease. Agriculture in this country has now an opportunity such as has never before been presented. A system of experimenting has been endowed with means sufficient to enable it to work in a thoroughly scientific spirit to discover the causes of the difficulties which confront the farmer, and when these causes are known, to suggest methods for his relief. There is, however, great danger that a demand for so-called practical work will seriously hamper the stations in the proper conduct of their work. Indeed, it is still possible that our stations will not be able to resist the pressure upon them to popularize their work by lowering its scientific character. That this may not be done, but that the present encouraging tendency of the stations, as a rule, to improve the quality and narrow the scope of their investigations may be continued and strengthened, the "model farm" idea, however disguised, should be strongly resisted, and pains should be taken by the friends of agricultural science to explain to the people the fallacy of the arguments urged in behalf of this disproved theory of agricultural experimenting.

The principle which renders it best that the station should make its farm one of its instruments rather than its chief feature is in reality the same as that which makes it so desirable that the stations be connected with agricultural schools. The explanation of this is simple enough. Plows and mowing machines are meant for the use of the farmer and the field is the place to use them; but the factory, not the farm, is the place to make them. The best men to manufacture them are those especially trained for the purpose. The best location for a factory is where facilities for communication and for the employment of help, and other circumstances are most favorable for manufacturing. The knowledge obtained by the experiment station is likewise for the benefit of the farmer, but, generally speaking, it will be obtained in the largest amount, of the most useful quality, and at the least cost, not on the farm and by practical farmers, but in institutions provided with well-equipped laboratories and trained specialists, where the best investigators can be secured, and where the workers will be supplied with the best facilities for making experiments under conditions which they can control and with the libraries and association with their fellow specialists which educational institutions furnish.

The difficulty with farm experiments is that they are so apt to be inconclusive. The great objection to having a station on a farm, unless it be close to a large town or an educational institution, is its isolation. The farmers do not visit it and its workers are left without the intellectual attrition which is essential for the best success. The advantages of connecting the station and the school are manifold. The station has the benefit of the appliances and the associations of the school, and the school, both teachers and students, has the corresponding benefit of contact with the station and its experimental work.

It is certainly worth noting that while the usefulness of farm experiments as lessons and means for enabling farmers to apply abstract principles to their practice and for bringing the stations into close contact and sympathy with the agricultural public is becoming better and better appreciated, the experimental farm and especially the "model farm" as an adjunct of the station has rarely, if ever, proved successful in the long run.

It was a wise provision of Congress that the stations should be connected with the colleges. The effort to separate the two will be to the disaster of both.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

Alabama College Station, Bulletin No. 21 (New Series), December, 1890 (pp. 15).

A NEW ROOT-ROT DISEASE OF COTTON, G. F. ATKINSON, PH. B. (pp. 3–11, illustrated).—Notes on observations by the author on a root rot of cotton occuring in Alabama, which was caused by the root-gall nematode (*Heterodera radicicola*, Müll.). The article is illustrated with a plate made from a photograph of specimens of the diseased roots of cotton.

The external manifestations of the disease in cotton are strikingly similar to those of the root-rot disease caused by *Ozonium auricomum* as described by Pammel [See Texas Station Bulletin No. 7, or Experiment Station Record Vol. I, p. 318], the irregular distribution of the spots as well as the tendency to increase in extent, and sometimes the changing of the spots. Also as in the case of *Ozonium*, the first external sign of the disease is the sudden wilting of a plant on a hot, sunshiny day, especially after rain. This similarity in external appearance is easily accounted for from the nature of the disease, since the condition of the roots prevents the absorption of water in quantities equal to that transpired by the leaves, though there be an abundance of water in the soil. From this time the plant rapidly declines.

The diseased plants begin to die about the time of "chopping out" the cotton in May, when the plants are quite small, and the disease continues throughout the season.

An account of the nematode worm is given, together with suggestions as to remedies, which are largely taken from the author's article on nematode root-galls in Bulletin No. 9 (new series) of the station (See Experiment Station Record Vol. I, p. 185). The importance of keeping the soil free from the nematodes by taking care not to plant infected roots or tubers is strongly urged, especially in view of the fact that no sure remedy for the worms is known after the land is once infected with them. Rotation of crops and clean cultivation are the chief means advised for reducing the numbers of these worms.

REPORT OF THE ALABAMA WEATHER SERVICE FOR NOVEMBER, 1890, P. H. MELL, PH. D., AND J. M. QUARLES (pp. 12–15).—Notes on the weather and a tabulated monthly summary of meteorological observations and of soil temperatures at depths of from 1 to 96 inches.

Alabama College Station, Bulletin No. 22 (New Series), January, 1891 (pp. 29).

EXPERIMENTS WITH COTTON, J. S. NEWMAN AND J. CLAYTON (pp. 3–24).—These included a test of varieties and experiments with fertilizers.

Test of varieties.—Notes and tabulated data for seven varieties. Southern Hope, Peterkin, and W. A. Cook produced the most valuable lint.

Experiment with phosphate.—In an experiment with cotton on a piece of new land phosphoric acid was applied on two plats, phosphoric acid and cotton-seed meal on two, and no manure on one. The results as tabulated, indicate that the decomposition of vegetable matter in the soil did not furnish all the nitrogen needed by the cotton plant, and that while the soil was deficient in phosphoric acid the profit was not as great with 1,000 pounds as with 500 pounds per acre.

Floats vs. acid phosphate.—The results of an experiment on sandy drift, long in cultivation, in which floats were compared with acid phosphate, agreed with those of similar experiments in previous years in showing that "in conjunction with cotton-seed meal floats were more profitable than acid phosphate."

Cotton at different distances and with different quantities of manure.—Cotton was planted at distances of from 3 by 1 feet to 4 by 5 feet, and was manured with cotton seed meal and acid phosphate, each ingredient being used at the rate of either 250 or 500 pounds per acre. The results as tabulated, agree with those of similar experiments in 1889 in indicating that 4 by 2 feet was the best distance to plant cotton on this land, and that doubling the amount of the fertilizer was not profitable.

Soil test of fertilizers with cotton.—In 1890 an experiment was made on fifteen plats in a field which had not been cultivated for many years. The fertilizers used were sulphate of ammonia, dissolved bone-black, and kainit, singly, two by two, and all three together; floats alone and in combination with sulphate of ammonia or green cotton seed, stable manure, and green cotton seed, singly. Three plats received no manure. The tabulated results, indicate that this soil needed nitrogen and potash but was most deficient in phosphoric acid for the production of cotton. The use of fertilizers seems to have hastened the maturity of the crop, and kainit had a favorable effect in retarding the appearance of blight.

While the stable manure produced the largest increase and the largest profit per acre, attention is called to the fact that it was applied at the rate of nearly two tons per acre, or half a ton more than the amount annually saved from each mule kept. There is no question about the efficacy of good stable manure properly used, but the available supply is too small.

Intercultural manuring.—On two plats to which cotton-seed meal and phosphoric acid had been applied before planting, additional amounts of cotton-seed meal were applied at the first (June 18) and last (July 30) plowing. The results as tabulated, indicate a large increase in the yield of seed cotton from the intercultural applications.

REPORT OF ALABAMA WEATHER SERVICE FOR DECEMBER, 1890, P. H. MELL, PH. D., AND J. M. QUARLES (pp. 25–29).—Notes on the weather and a tabulated monthly summary of meteorological observations and of soil temperatures at depths of from 1 to 96 inches.

Alabama Canebrake Station, Third Annual Report, 1890 (pp. 10).

A brief outline of the work of the station, with abstracts of Bulletins Nos. 7–10.

Previous to the establishment of this station large sums were annually expended by canebrake planters for commercial fertilizers. The experiments at the station have plainly demonstrated the inefficiency of such compounds, while they have equally plainly shown that the owners of canebrake lands have the means of restoring their worn soils in the two leguminous plants, peas and melilotus, which supply at once the two greatest needs of the black prairies—drainage and vegetable matter, and through the latter nitrogen.

Arizona Station, Bulletin No. 1, December 1, 1890 (pp. 4).

ORGANIZATION OF THE ARIZONA STATION, F. A. GULLEY, M. S.—"The Agricultural Experiment Station of the University of Arizona was organized temporarily July 1, 1889, and permanent organization was made October 9, 1890." The headquarters of the station are at Tucson, but substations are to be established at various places in Arizona. Fruit growing will receive especial attention, as this promises to be a leading industry in the Territory.

Four field stations have been located: (1) The University station at Tucson, on the university grounds, which have a gravelly loam soil overlying a "caliche," soft lime rock at a depth of from 2 to 6 feet; permanent water at 80 feet, and on a small tract of sandy land near by, with water at 30 feet. (2) The Phœnix station, 2 miles northwest of the city, where 80 acres of land have been provided, varying from light sand to a rather close adobe, with water at from 25 to 30 feet. (3) A station 3 miles south of Tempe, at a switch and flag station on the Phœnix and Maricopa Railroad, on mesa soil, with water at about 12 feet. (4) Blaisdell station at Blaisdell, 9 miles east of Yuma, on the Southern Pacific Railway, on a fine sedimentary soil, with water at about 15 feet.

The University station is representative of a large area of land in the central and eastern part of the Territory, and here we shall make the experiment of pumping water 85 feet for irrigation. The Phœnix station and the one south of Tempe represent a considerable part of the Salt River Valley, and the Blaisdell station does the same for the Lower Gila River. Having access to alkali lands in the immediate vicinity of the last-named place, the question of how to reclaim such soils will at once be taken up for investigation.

A large number of varieties of fruits, including nearly all that have been found of value in California, will be planted at the four stations during the winter, as well as other plants of economic interest, including the sugar-beet, sugar-cane, cotton, grasses, forage plants, etc., and the results obtained recorded and published from time to time. As soon as the chemical laboratory is equipped, which will be about the last of January, 1891, we shall begin an examination of the waters of the several streams and of the wells in the Territory used for irrigation, and a chemical analysis of soils and of other materials.

Florida Station, Bulletin No. 12, January 1, 1891 (pp. 16).

TOBACCO, COTTON, RICE, AND SORGHUM, J. P. DE PASS (pp. 3–11).—Brief accounts of experiments with these crops, and directions for the culture of tobacco.

ASHES AS A FERTILIZER, J. M. PICKELL, PH. D. (pp. 11–13).—An explanation of the value of wood ashes as a fertilizer.

MISCELLANEOUS ANALYSES, J. J. EARLE, B. A. (pp. 13–15).—Tabulated results of ash analyses of pine straw, pine burr, pine bark, oak leaves, beggar weed, rag-weed, and Spanish moss.

Georgia Station, Third Annual Report, 1890 (pp. 8).

This contains the reports of the governing board, director, and treasurer of the station, which include brief accounts of the work and publications of the station for the year 1890.

Georgia Station, Bulletin No. 10, December, 1890 (pp. 20).

FERTILIZER EXPERIMENTS ON CORN, R. J. REDDING (pp. 129–140).

Special nitrogen experiments.—An account is given of two experiments on the station farm, each on twenty-five plats, three fortieths of an acre in size, the object of which was "to find out whether corn, in the climate and soils of Georgia, is benefited by the application of nitrogenous fertilizers, and in what forms and in what quantities, having due regard to character of soil, the nitrogen may be most profitably applied." The two experiments were exactly alike, except that one half of the land used for No. 2 was subsoiled, "the object being to ascertain the effect of subsoiling on the crop." The land had been used for cotton the previous year, for which it was well fertilized. "The quality was by no means as uniform as could be desired for such a test, as is shown by the varying yields of the unfertilized, and of the identically fertilized plats." The fertilizers applied were the same in both experiments as those recommended in Circular No. 7 of this Office, except that dried blood was only used on one plat; that stable manure was applied to one plat; and that cotton-seed meal, 360 pounds per acre, was used alone, and the same quantity, 720 pounds, and 1,080 pounds were each combined with mixed minerals (superphosphate and muriate of potash). The tabulated data include the rain-fall at the station for each month during the growing season, the fertilizers applied and their cost per acre, and the yields of corn per plat and per acre. The results were suggestive but not conclusive, the land not being sufficiently uniform in fertility, and the results of the two experiments not fully sustaining one another. The general indications derived from these experiments were as follows:

(1) The nitrogenous fertilizers materially increase the yield of corn.

(2) Nitrate of soda is better for corn than either sulphate of ammonia, cotton-seed meal, dried blood, or stable manure.

(3) It is easy to apply too much nitrogen to corn.

(4) Nitrogen in moderate quantity, combined with phosphoric acid and potash, is better than when used alone, on corn.

(5) Superphosphate does not give satisfactory results when used alone on corn.

(6) It is not advisable to apply potash alone on corn.

(7) The mixed minerals—superphosphate and potash—combined with a moderate dose of nitrate of soda, give the best results.

The half of the field which was subsoiled in the second experiment averaged 25.08 bushels of shelled corn per acre, as compared with 24.19 bushels on the half not subsoiled, a difference of 0.89 bushel. After the crop of corn was harvested a spontaneous growth of crab-grass (*Panicum sanguinale*) sprang up, the growth of which on the differently fertilized plats was noted.

The greater luxuriance of the grass on the nitrogenized plats, the luxuriance increasing as the quantity of nitrogen was greater, suggests that there was more nitrogen than the corn crop could take up and appropriate. The failure of the volunteer crop of grass in the stable-manure plat is inexplicable except on the hypothesis that the organic nitrogen of the stable manure was more assimilable and consequently more completely removed from the soil than the nitrogen of the dried blood, the nitric acid of the nitrate of soda, or the ammonia of the sulphate. But what became of it? It did not increase the yield of corn.

Intercultural fertilizing.—"The object of this experiment was to find the effect of dividing a given amount of fertilizer into two or more portions and applying these portions successively at stated periods" during the growing season. Five plats, about one fourteenth acre each in size, and of gray, sandy, nearly level soil, were planted to corn. A fertilizer at the rate of 168 pounds superphosphate, 189 pounds cotton-seed meal, and 64 pounds muriate of potash per acre was applied on four of these plats, either all before planting, one half before planting and the other half later, or one third before planting and the balance in two separate applications. One plat received no fertilizer. The yield of shelled corn per acre is given for each plat. The largest yield (22.7 bushels) was on the plat to which the whole amount of fertilizer was applied before planting. "While not decisive, the results indicate that one undivided application, at or before the time of planting, will give as large a final yield as when divided into two or more portions. * * * This experiment will be repeated next season."

FODDER PULLING, R. J. REDDING (pp. 140–142).—The object of this experiment was to ascertain the advantages of the practice, which "is well-nigh universal in the leading cotton States," of stripping the leaves from the stalks of corn, for feeding purposes. Thirty-eight rows of corn, each 270 feet in length, served for the trial. August 17 the blades were pulled from the stalks in every even-numbered row. The weights of the cured leaves and of the corn from the rows "pulled" and those "not pulled" are stated for each plat.

On careful examination of the table it will be observed that the weights of corn yielded by rows from which the blades were stripped exceed those from the corresponding unstripped rows in only three instances. With these exceptions every unstripped row exceeded its adjacent stripped row by 1.7 to 10.2 pounds of corn in the ear, averaging 5.76 pounds; while to compensate for this loss of corn the stripped rows yield an average of 13.4 pounds of fodder.

Calculating the results for one acre, and allowing 78 cents per acre for the cost of pulling, $1 per hundred pounds for the cured leaves pulled off, and 85 cents per bushel for the shelled corn, the financial result is $1.62 in favor of the pulling.

DEEP VERSUS SHALLOW CULTURE OF CORN, R. J. REDDING (pp. 143, 144).—A piece of sandy soil, with a hard, yellow clay about 1 foot beneath the surface, was divided into five plats, each containing about one fourteenth of an acre. The land "had been in weeds the previous year." All the plats were fertilized alike, and planted with Bates corn.

"The entire section was plowed the first time, deep and close, with scooter plows, April 29. Plowed second time May 17, plats 1, 3, and 5 very shallow, with Planet, jr., cultivator, with small sweeps attached; plats 2 and 4 very deep with scooters, out and out. Plowed third time June 2, plats 1, 3, and 5 very shallow, as before; plats 2 and 4 very deep with shovel plows. Fourth plowing June 24, same as third plowing."

The blades were stripped from all the plats August 13, and the corn harvested October 17. The table of results shows the yield of shelled corn and of cured fodder per acre on each plat. The plats receiving shallow culture averaged 2.4 bushels of shelled corn per acre more, and 38 pounds of cured fodder less than those receiving deep culture.

VARIETY TEST OF CORN AND BROADCAST MANURING, R. J. REDDING (pp. 144–146).—Tabulated notes are given on 21 varieties of corn, including the yield of each variety when the fertilizer (superphosphate, cotton-seed meal, and muriate of potash) was applied in the hill and when applied broadcast.

"The lesson to be drawn from the result is, that if the season proves unfavorably hot and dry it were better that the fertilizer be more generally and uniformly distributed throughout the surface soil, especially if the fertilizer be used in large quantity."

COTTON SEED (CRUSHED) VERSUS COTTON SEED MEAL FOR CORN, R. J. REDDING (p. 147).—A brief account of an experiment to test the effects of equivalent amounts of crushed cotton seed and cotton-seed meal on corn. The "location was unfortunate," and the results of the experiment were "totally unreliable and insignificant."

CORN AT DIFFERENT DISTANCES, G. SPETH (p. 148).—In this experiment, made on a piece of land 104 feet long by 45 feet wide, the rows were all 5 feet apart, and the hills 2, 3, or 4 feet apart in the rows. "The land was a good chocolate clay loam, with clay subsoil." The data given include for each plat the number of hills per acre, number of large ears and nubbins, and the yield of shelled corn per acre. The largest yield of shelled corn was where the hills were 4 feet apart in the rows, and the largest number of nubbins where they were 2 feet apart.

Georgia Station, Bulletin No. 11, January, 1891 (pp. 46).

COTTON, FERTILIZER AND CULTURE EXPERIMENTS, AND VARIETY TESTS, R. J. REDDING (pp. 1–21).

Special nitrogen experiments (pp. 1–11).—The two experiments reported in this connection are similar in general plan to those made with corn and reported in Bulletin No. 10 of the station (See above). The fertilizers used were the same and used in the same combinations, except that dried blood in one third, two thirds, and full rations was added, and crushed cotton seed was applied on one plat; but the amount of each single material or mixture used was only a little more than half that used in the previous experiments.

Each experiment was made on 28 fourteenths-acre plats. The land occupied by the two experiments was not altogether uniform—that used for one of them being somewhat uneven as regards the quality of the soil. "Peterkin" cotton was planted April 16. "The season was favorable, and a good stand was maintained—one stalk about every 16 inches." The results of the experiments are given in three tables, which show the yields per acre of seed cotton and of lint on each plat; the increased yield of lint with the use of mixed minerals, and of nitrogen; the value of the same, and the cost of the added fertilizer; the profit (or loss) on nitrogen and on mixed minerals; and the total profit. The author does not consider that the results warrant final conclusions. Those of the two experiments are in some instances conflicting, and in others indicate a lack of uniformity of the soil.

Notwithstanding the occasional discordance, the experiments are of considerable value—more, perhaps, to the experimenter than to the farmer.

The results indicate—

(1) That the soil is deficient in both phosphoric acid and potash, especially in the former on the sandy portion and in the latter on the clayey portion. Neither phosphoric acid alone nor potash alone gave as good results as when combined with each other.

(2) That the soil also requires nitrogen in some form in order to produce the best yield of cotton. Nitrogen alone produced little or no effect, but very decided effects when mixed with phosphoric acid and potash.

(3) That the use of stable manure and of cotton-seed, composted with superphosphate and muriate of potash, is to be strongly recommended, as far as materials are available, on account of superior economic results.

(4) That cotton responds promptly and profitably to applications of nitrogenous manures, and is not very choice about the source or form of this element, but prefers it rather in organic form or in nitrate than in the form of sulphate of ammonia.

Intercultural fertilizing of cotton (pp. 11–13).—The object and general plan of this experiment were similar to those of the experiment with corn reported in Bulletin No. 10 of the station (See above). Five plats, each containing four rows of cotton 209 feet long, and on "well-improved clayey loam land" were used for the trial. Fertilizers were applied at the rate per acre of 336 pounds of superphosphate, 168 pounds of muriate of potash, and 373 pounds of cotton-seed meal. One plat received

no fertilizer. The yields of cotton per plat and per acre, the increased yield over the unfertilized plat, and the cost of the fertilizer are tabulated. The conclusions given are as follows:

(1) It is manifest that marked effects result from intercultural fertilizing, or successive applications of fertilizers during the growing period.

(2) Larger doses applied at planting, or during the earlier periods of growth, result in early maturity of the crop.

(3) Whenever a heavy application of a readily available fertilizer is to be made it would be advisable to divide it into at least two doses and possibly more.

The experiments will be continued the coming season.

Topping cotton (pp. 13–15).—For this experiment sixteen rows were laid off on a piece of good land, the rows being 3.73 feet wide and 209 feet long. The cotton on one row of each of the four plats into which the experimental field was divided was topped July 1 (plants 12 inches in height), July 15 (24 inches), and August 1 (36 inches). The fourth row of each plat was left untopped. A table shows "the weights of seed cotton gathered from each row of each plat at each of the three pickings, together with the total yield of each row and the estimated yield in pounds of lint per acre. * * * The untopped rows made an average yield of 633 pounds of lint per acre; the rows topped July 1, 505 pounds; those topped July 15, 615 pounds; and those topped August 1, 619 pounds. * * * It is plain that the topping at each of the periods (July 1, July 15, and August 1) proved injurious instead of beneficial, and that the earlier the topping was done the greater was the injurious effect."

The author is inclined to believe that the experiment might have resulted differently if the plants had had more "distance." Investigations in this line will be continued.

Deep vs. shallow culture of cotton (pp. 15–17).—In the culture of cotton "the weight of opinion and practice of late years has been on the side of deep preparation, but shallow after-culture. There are many, however, who yet hold to the idea that cotton should be plowed deep and close, especially in time of drought. * * * The object of this experiment, which will be repeated indefinitely, is to determine the relative effects of deep or shallow culture on the final yield of the crop." Five plats of four rows each, adjoining those on which the two experiments mentioned above were conducted, and receiving the same preparatory treatment, "were plowed close and deep the first time. At each subsequent plowing plats 1, 3, and 5 were plowed as shallow as possible with a five-hoe cultivator (small sweep hoes) running twice in a row, and plats 2 and 4 were plowed as deep as possible with the same implement, but using instead of the sweep blades five 1½-inch scooters, set close and running three times in a row."

The yield of seed cotton from each plat at each of four pickings, the total yield of seed cotton per plat, and the yield of lint per acre are recorded in a table. "Calculated to yield of lint per acre, the

shallow-culture plats made 540 pounds and the deep-culture plats 514 pounds of lint per acre, a difference of 26 pounds" in favor of shallow culture.

Test of varieties of cotton (pp. 17-20).—Tabulated data and brief descriptive notes are given for 24 varieties grown in 1890 on a "rather heavy clay loam" liberally fertilized with superphosphate, cotton-seed meal, and muriate of potash. The largest yields of lint and seed cotton were produced by Peterkin, Keith, T. J. King, Hawkin's Jumbo, Dickson's, Welborn's Pet, Texas Storm and Drought-Proof, Truitt's Imperial, Hunnicutt's, Minter's, and Mikado.

Hill vs. drill culture of cotton (pp. 20, 21).—Cotton was planted in hills 3¾ by 3¾ feet, on one half of a field of 45 rows, and in drills 3¾ feet by 19 inches on the other half. The yields are reported in a table, but inasmuch as the drilled half of the field was much better land than the other half no definite conclusions can be drawn from the experiment. Attention is, however, called to the following facts and suggestions:

One acre computed to contain 3,136 hills, but actually containing 3,046 stalks, produced 508 pounds of lint; while the other acre, planted in drills and containing by actual count 7,952 stalks, yielded 593 pounds of lint. It is quite probable that the drilled plat would have produced a larger yield if the distance between the stalks had been increased from 19 to 24 or 30 inches, while it is almost demonstrably certain that the hill portion would have yielded a much larger product if the distance one way had been 36 inches instead of 44. The conclusion is suggested that a medium between the number of stalks standing on the hill portion and that on the drilled portion would have given a larger yield. It required (at least there were actually used) 2 bushels of seed per acre to plant the drilled plat; the hilled plat required 1 peck, a saving of 1¾ bushels of seed per acre. At 50 cents per bushel (a moderate price for good planting seed) this saving would amount to 87½ cents, more than sufficient to pay for the extra labor of planting the cotton in hills. The labor of hoeing the hilled plat was less than half that required by the drilled plat.

The result of the experiment suggests the importance of regulating the distance and the number of stalks according to some definite rule, not subject to the whim or careless judgment of an ignorant laborer.

EXPERIMENTS IN THE CULTURE OF SWEET-POTATOES, TOMATOES, CABBAGES, ETC., G. SPETH (pp. 22-46).

Sweet-potatoes (pp. 22-29).—In view of the importance of this crop in the Southern States, the station has undertaken a variety of experiments with sweet-potatoes. This article contains a report on experiments (1) in planting at different distances, and (2) with fertilizers. The land used in both cases was a clay loam with clay subsoil.

Planting at different distances.—The yields for 3 varieties planted at distances of 1½ by 4, 2½ by 4, and 2 by 4 feet are given in a table, those for the last mentioned distance being the best.

Fertilizer experiment.—In this "the effect of varying rations of different potash salts in combination with full rations of superphosphate and cotton-seed meal" was tested with 5 varieties of sweet-potatoes. Kainit and muriate of potash in half, full, or double rations were each used along with the other fertilizers on three plats, and four plats

received no manure. The results are summarized in four tables. The largest yields were obtained when the full ration of potash was used.

Cabbages (pp. 29–31).—Tabulated data are given for some 30 varieties planted late in the spring.

Tomatoes (pp. 32–37).—Tests of varieties and experiments with fertilizers are reported.

Tomatoes, tests of varieties.—Tabulated data for 32 varieties, and brief descriptive notes on the 10 most productive varieties, viz., Horsford's* Prelude, Cumberland Red, Essex Hybrid, Golden Queen, Ignotum, Optimus, Puritan, Red Cross, and Table Queen.

Tomatoes, fertilizer experiment.—Nitrate of soda, cotton-seed meal, muriate of potash and superphosphate (mixed minerals), and the minerals in combination with different amounts of either nitrate of soda or cotton seed meal, were used on seven plats, and one plat received no manure. The results, as tabulated, indicated that—

(1) The application of nitrogen alone gave no increase over the unfertilized plat; (2) minerals produced a marked increase; (3) nitrogen in single ration in combination with mixed minerals showed a decided gain over mixed minerals alone; (4) the largest yield was attained by the application of double rations of nitrogen and mixed minerals; (5) the effect of nitrogen depends upon the presence of the mineral elements, phosphate and potash; (6) earliness is in proportion to the effectiveness of the fertilizer.

Peas (pp. 37–40).—Tabulated data for 27 early and 16 late varieties.

Beans (p. 41).—Tabulated data for 30 varieties.

List of fruits planted at the station in 1890 (pp. 43–45).—This includes 47 varieties of apples, 6 of cherries, 14 of figs, 42 of peaches, 36 of pears, 26 of plums, 5 of quinces, 48 of grapes, 13 of blackberries, 14 of raspberries, and 51 of strawberries.

Illinois Station, Bulletin No. 13, February, 1891 (pp. 64).

FIELD EXPERIMENTS WITH CORN, G. E. MORROW, M. A., AND T. F. HUNT, B. S. (pp. 389–432).—This article gives a detailed account of experiments with corn in 1890, together with a summary of the results of similar experiments in 1888 and 1889, which were recorded in Bulletins Nos. 4 and 8 of the station (See Experiment Station Record, Vol. I, p. 28, and Vol. II, p. 14). The following subjects were treated: test of varieties; time of planting; depth and thickness of planting; planting in hills or drills; frequency and depth of cultivation; root growth; effect of root pruning and of fertilizers; rotation of corn, oats, and timothy or clover, or both; and rotation of corn and oats compared with continuous cropping with corn.

These experiments were made on a black loam about 20 inches deep, underlaid with yellow clay—the soil common to the prairies of Central Illinois. Apparently the plats were notably uniform, and admirably adapted to field experimentation.

Judged by the results, 1888 was unusually favorable for the corn crop, 1889 much less favorable, and 1890 still less than 1889. The yield of air-dry corn per acre from the medium maturing varieties for the three years was 90, 75, and 62 bushels respectively.

In 1889 the rain-fall was unfavorably distributed, and the temperature was below normal; in 1890 the rain-fall was very deficient, but the temperature was more propitious during the corn months.

Experiment No. 1.—Corn, test of varieties (pp. 392–404).—The varieties tested in 1890 included 28 yellow dent, 13 white dent, 1 mixed dent, 1 flint, and Brazilian flour corn. The results, as in the case of the similar experiments previously reported, are given in detail in tables, with summaries, general notes, and a meteorological record of the growing season of 1890.

Experiment No. 3.—Corn, time of planting (pp. 405–407).—In 1890 corn was planted at seven different dates at intervals of a week, from April 28 to June 9. The details and results are stated in tables giving dates of planting and cultivation, implements used, yield of corn, and per cent of water in corn.

Experiment No. 4.—Corn, depth of planting (p. 407).—May 8, 1890, six rows, each 6 rods long, were planted at depths varying from 1 to 6 inches with Burr's White corn, four kernels to the hill. The yields are reported in a table and compared with those for 1888 and 1889.

Experiment No. 5.—Corn, thickness of planting (pp. 407–415).—In 1890, as in previous years, "this experiment was conducted to determine not only the best thickness at which to plant corn, but also the best manner of distributing the seed at a given thickness, whether, for instance, to plant three kernels every 42 inches or one kernel every 14 inches." Burr's White corn was planted "at six different degrees of thickness as follows: 47,520, 23,760, 15,840, 11,880, 9,504, and 5,940 kernels per acre." Tables show for each planting the number and weight of stalks and ears harvested; the yields of fodder, stover, and shelled corn, and pounds of stover for each pound of shelled corn, in 1888, 1889, and 1890; detailed data for 1890; and the yield of dry matter and digestible substance per acre in 1890.

Experiment No. 6.—Corn, planting in hills or drills (p. 415).—Three plats, containing 0.433 acre each, were planted with the same quantity of Burr's White corn, one plat in drills and the other two in hills. One of the plats planted in hills was cultivated both ways, the other two one way. The yields of shelled corn in bushels per acre, as stated in a table, were 60.8 on the plat planted in drills, 71.7 on the plat planted in hills and cultivated one way, and 77.7 on the plat cultivated both ways.

Experiments Nos. 8, 9, and 10.—Frequency and depth of cultivation and root pruning (pp. 416–423).—In 1890, as in previous years, these were practically one experiment with three sets of conditions. In No. 8, in which the effects of frequency of cultivation were tested, the comparison was between cultivating four times (ordinary cultivation), five times (ordinary cultivation, and once after tasseling), and thirteen times.

In No. 9 the effects of deep and shallow cultivation were compared on one piece of land; and on another piece the effects of preparing the seed bed at different depths were tested, the soil not being stirred after the planting of the corn.

The tract was scraped with sharp hoes to remove weeds with the least possible disturbance of the soil, three times between May 28 and June 27.

The yield of corn in bushels per acre was as follows:

The effect of preparation of seed bed upon yield, 1890.

Plat.	Preparation of seed bed.	Yield per acre.
		Bushels.
1	Not plowed	56.4
2	Plowed 2 inches deep	59 9
3	Plowed 4 inches deep	69.4
4	Plowed 6 inches deep	69.3
5	Plowed 8 inches deep	71.7

It is evident that on this soil good crops of corn may be raised with differently prepared seed beds, without any stirring of the soil after the corn is planted, if the weeds are thoroughly removed.

In No. 10 the effects of root pruning 4 inches deep and 6 inches from the hill at the second, third, and fourth cultivations were observed. The results of the several experiments are stated in tables and are discussed in some detail.

Experiment No. 54.—Corn, root growth (pp. 423–428).—"As stated in former bulletins, the particular object of inquiry in this experiment was to ascertain the number of the roots of corn and their depth at the points where they were likely to be disturbed by cultivation, and what proportion of all the roots was likely to be so injured." In 1890, fifteen plants of Burr's White corn, containing 254 roots, were examined at different dates from May 24 to June 28, and the results are stated in detail in a table and briefly discussed.

At the first week of examination, when the plants were from 1 to 2½ inches high, there were three and four roots per plant. At the last examination, when the plants were 62 to 65 inches high, they had thirty five roots apiece. The longest root traced was 53 inches, while another was found which was 51.5 inches long. Three were broken off at 50 inches or more, probably near their end. Twelve were traced between 40 and 50 inches, some of which were broken at the lengths given.

Two thirds of the roots would have been broken by root pruning 4 inches deep; more than two fifths would have been broken at 3 inches deep; and one seventh at 2 inches deep.

In 1890, as in 1889, it was found that the depth of planting had little or nothing to do with the depth at which the roots grew. The first whorl of roots, other than those distinctly at the seed, which generally, if not always die, began to grow at from 1 to 2 inches from the surface of the soil, without reference to the depth at which the seed was planted. The stem between the seed and the first nodal whorl of roots is simply elongated and more slender if the seed is planted deeper. Nothing is gained, therefore, by planting deeper than 2 or 3 inches in this soil, unless the dryness of the soil makes it essential. On the other hand, if it is necessary to plant deeper on account of the dryness of the soil, or to plant some of the corn deeper where planting

with a corn planter on uneven ground so that all the corn may be covered, both the study of the roots and the results of Experiment No. 4 (depth of planting) indicate that little, if any harm will result.

Experiment No. 24.—Corn, effect of fertilizers (pp. 428–431).—The results of experiments in 1888, 1889, and 1890 are summarized in tables. The fertilizers used were stable manure, hog and cattle tankage, muriate of potash, superphosphate, sulphate of ammonia, and nitrate of soda.

There was an increased yield of 9 bushels per acre on the plat fertilized with stable manure each season over those plats receiving no manure. The average yield of corn on the eight plats treated with commercial fertilizers was about 1 bushel less than on the two plats receiving no manure. On no plat so treated was the yield over 2 bushels more than on those receiving no fertilizers.

Experiment No. 23.—Rotations with corn, oats, and meadow, and with corn and oats, compared with continuous cropping of corn (pp. 431, 432).

This experiment is introduced here on account of its bearing upon the question of the application of fertilizers for the production of corn.

Briefly, ten half-acre plats, 5 by 16 rods, have been cropped during the past 14 years as follows: plats 1, 2, and 3 have been in corn continuously; plat 4 in corn and oats alternately; and plats 5, 6, 7, 8, 9, and 10 have had this rotation: corn, 2 years; oats, 1 year; meadow (clover, timothy, or both), 3 years.

From plats 1, 2, and 3 both corn and stocks have been removed. Plat 1 has had a liberal application of stable manure each year. Plat 3 has had no fertilizer of any kind applied. * * *

[Dissolved bone-black, muriate or sulphate of potash, and sulphate of ammonia were applied on plat 2 in 1888, 1889, and 1890.]

The half acre which had been manured 13 years successively with stable manure yielded in 1888 about one fourth; in 1889, after another liberal application of stable manure, about three fourths; and in 1890, after still another liberal application of stable manure, about one third more corn than the unfertilized half acre upon which corn has been raised continuously for 15 years. Averaged for 3 years, the plat which received stable manure yielded about 38 per cent more than the plat not fertilized. The average increase in yield was 18.4 bushels per acre. At 35.7 cents per bushel, the average farm price of corn in Illinois during 12 years (1876–87), this increase would be worth yearly $6.56. The plat receiving commercial fertilizers yielded during the 3 years a little less (although practically the same) than plats receiving no fertilizer of any kind.

A table shows the yield on each plat for 1888, 1889, and 1890.

Summary of experiments with corn (pp. 390–392).

Among the many varieties of dent corn tried one or more years, twelve have been tested in 1888, 1889, and 1890, and each has averaged 67 bushels per acre or more, the largest average yield being 80 bushels. Of the yellow varieties, Leaming, Fisk, Legal Tender, Clark's Iroquois, and Riley's Favorite are medium-maturing, and will be found desirable for Central Illinois. Steward's Improved is too late for this locality. Murdock and Edmonds are early-maturing and may be grown farther north. Of white varieties, Champion White Pearl or Burr's White, and Clark's 110-Day are medium-maturing and desirable for Central Illinois. Helm's Improved is almost too late for this locality.

The stand of corn has been about 10 per cent less than the per cent of kernels sprouting under test conditions.

Barrenness does not seem to be a variety characteristic, but depends largely upon the season and the thickness of planting. The stalks had many more ears in 1889 than in 1888 and 1890. There were fewer barren stalks where corn was planted at

the ordinary rate of 12,000 kernels per acre than at either thicker or thinner planting. When four times as many kernels were planted one half the stalks were barren.

Without exception the medium-maturing varieties (maturing about September 20) have given each year a higher average yield than either the early or late-maturing varieties—from 7 to 20 bushels higher than the former, and from 2 to 7 bushels higher than the latter.

The per cent of water in the kernel of the corn when husked varies with the variety and with the season. During the 3 years the early-maturing varieties have contained an average of 17.1 per cent of water; the medium-maturing, 21.3 per cent; and the late-maturing, 26.4 per cent. (Thoroughly air-dry corn contains about 11 per cent of water.) Taking an average of the three seasons, the loss in weight of shelled corn from November 1, when the crop was gathered, until it became thoroughly air-dry was, for the medium-maturing varieties, at the rate of 115 bushels in 1,000 bushels. The loss from drying in 1890 was only about half that of 1888 and 1889. Seventy-five pounds of ear corn were ample to give for a bushel of corn on November 1, 1890; but in 1889, 80 pounds were not sufficient.

Good crops of corn were raised from a medium-maturing variety when planted at any time during May. Planting in the last week of April gave somewhat poorer results, and the land uniformly required more cultivation to keep it equally free from weeds. When the corn was planted after the 1st of June the yield was somewhat less and the corn did not always mature.

While during no season was there any direct relationship between the depth of planting and the yield, taking an average of the three seasons, the shallower-planted rows gave the larger yield. It was found that, not counting the roots directly at the seed, which afterwards die, the first whorl of roots starts at from 1 to 2 inches from the surface, without reference to the depth at which the kernel has been planted.

Corn planted at the rate of one kernel to every 12 inches, in rows 3 feet 8 inches apart, about 12,000 kernels per acre, gave a larger average yield of corn and a larger yield of good ears; and contained more corn in proportion to stalk by weight, and a larger proportion of ears to number of stalks, than when planted either thicker or thinner. The thinner the planting the larger were the single ears and stalks.

If the average of the 3 years be taken, the yield of corn fodder (corn and stalks) and corn stover (corn fodder after the corn has been husked) decreased constantly from the thickest to the thinnest plantings. Planting at the rate of one kernel every 3 inches, 47,520 per acre, gave a little larger yield of dry matter and of digestible substance than planting at twice that distance; but the yield of grain from the latter planting was so much better that it is believed the nutritive value of the crop for fodder purposes was greater where planted at the rate of one kernel every 6 inches, about 24,000 kernels per acre. The average yield of field-cured corn fodder from the five thicknesses of planting (one kernel every 3 inches to one kernel every 15 inches) during the 3 years, was nearly 6 tons per acre. Neither for fodder purposes, nor for the production of grain merely, was there any material difference in the yield whether one, two, three, four, or five kernels were planted per hill, the whole number of kernels planted per acre remaining the same, provided the land was kept equally clean.

In 1890, where the corn was planted in both hills and drills and given an equal amount of cultivation, which kept the corn in hills cleaner than the corn in drills, the result was decidedly in favor of the corn in hills. In 1888 there was no practical difference.

During the 3 years no appreciable benefit was derived from frequent cultivation nor from cultivating after the ordinary time.

For the 3 years the yield of corn has been increased by the shallow cultivation one tenth over the deep cultivation. The least increase in any one season was a little less than one twelfth in 1890 and the greatest increase one eighth in 1889. In but one case in the 3 years did a deep-cultivated plat yield more than a shallow-

cultivated plat. The plat which had no cultivation after planting, except that the weeds were removed by scraping with a sharp hoe, yielded more each season than the average of the deep-cultivated plats; and in but two instances, once in 1889 and once in 1890, did any one of the deep-cultivated plats yield more than the plat not cultivated. These experiments indicate that any cultivation of the soil which effectually removes the weeds, and at the same time disturbs the roots as little as possible, is the best, and that on this soil the stirring of the ground beyond what is necessary to kill the weeds is of little, if any, benefit. Undoubtedly it is better to disturb some roots than to allow weeds to grow.

Pruning the roots of corn to the depth of 4 inches, 6 inches from the stalk, has reduced the yield 16 and 23 per cent in 1889 and 1890, respectively. The reason that root pruning reduced the yield to a greater extent than deep cultivation is probably that the root pruning was done on all four sides of the hill at each pruning. The depth at 6 inches from the plant has been determined with 251 roots, and 174 were found to be 4 inches or less from the surface; 108, 3 inches or less from the surface. In other words, a cultivator running 4 inches deep would disturb about 70 per cent of the roots, and at 3 inches about 43 per cent. Of 115 roots on four plants examined June 21 and 28, the end, or the point where broken, of 54 was 12 or more inches deep; of 33, 18 or more inches deep; and of 17, 24 or more inches deep.

Twelve trials have been made of the effect upon a corn crop of fertilizers when applied to the prairie soil of Illinois. No practical benefit was obtained from the use of commercial fertilizers. The increased yields from the use of stable manure probably repaid the cost of the application and left some profit; but clearly the value of stable manure was not equal to the estimates often made, based upon the cost of commercial fertilizers containing the same amount of plant food.

Good crops of corn have been raised during the past 3 years from land which has now been in corn for 15 successive years, and has received no manure of any kind; while somewhat better crops have been raised where the land has been in corn but one third the time, and in timothy and clover one half the time.

GARDEN EXPERIMENTS WITH SWEET-CORN, 1890, T. J. BURRILL, PH. D., AND G. W. MCCLUER, B. S. (pp. 432-443).

Experiment No. 49.—Sweet-corn, test of varieties.—This is a continuation of an experiment previously reported in Bulletins Nos. 4 and 8 of the station (See Experiment Station Record, Vol. I, p. 33, and Vol. II, p. 19).

The grouping of sweet-corn, described in Bulletins Nos. 4 and 8, has been revised so as to bring together those so-called varieties that were nearly enough the same to appear to justify such a classification. Several of the varieties still left as distinct are so much alike that for all practical purposes they might be considered the same. There are but very few varieties so distinct that each does not approach one or more other varieties so nearly that the line of separation is very faint. The method of selection is evidently different among the various seed growers, and their facilities for keeping varieties separate must in many cases be very imperfect, since we get from the same dealer in different years seed under the same name, but differing so much as not to be recognized as the same. * * *

According to the tests so far made, there are still 49 varieties of sweet-corn distinct enough to be left separate. Of these there are several in each group so much alike that it would not pay to grow more than one of them at a time.

Dreer's, a selection from Cory, is the earliest corn. It does not all ripen at the same time, and will afford a supply until something better can be had. Ford's or Crosby would be selected for the next early variety. Ford's is very similar to Minnesota, but larger, clearer in color, and of better quality. Crosby has ten to fourteen rows of kernels, is below medium size, white, and of very good quality.

In the medium-early groups, Stabler's Early, Concord, Shakers', Pee and Kay, Squantum, and Asylum are recommended. Of late varieties, Old Colony is of better quality than Stowell's Evergreen, and it remains in condition for use nearly as long. * * * Of the shallow-grained late varieties there would be little choice between Mammoth, Hickox, and Henderson. * * * For farmers who do not care to plant more than a single variety, Crosby, planted at different times, would be as good as anything. The new varieties sent out every year at high prices, are almost certain to be a disappointment to the grower, since they nearly always fail to fulfill the claims of the introducer.

In the classification of sweet-corn the varieties are divided according to the time in reaching edible maturity after planting, into early, medium, late. Also on color: yellow, white, colored, not yellow. A further division of varieties is made into eight-rowed, and having more than eight rows.

Circumstances have made it impracticable to give any estimates of yields of corn grown the past season.

Classified descriptions are given for the 49 varieties recognized as distinct.

POP-CORN, TEST OF VARIETIES, T. J. BURRILL, PH. D., AND G. W. MCCLUER, B. S. (pp. 443–447).

The pop-corn varieties were primarily grown for botanical and other closely related studies, and especially in tests of cross-fertilization, from which interesting results are to be reported at another time.

The list of varieties of pop-corn grown the past season by the station is as full as it was possible to make it from the seedsmen's lists received. * * * So far, all the varieties of pop corn may be readily divided into two very distinct types or classes. One class is very commonly known as rice corn, and has kernels more or less pointed, with the outer coat, where the silks were attached, continued into a sort of spine, which may either stand almost erect or may be depressed by the crowding of the husk on the ear. The ears in either case are rough to handle. The other class, of which the white, at least, is frequently known as pearl corn, has kernels rounded or flattened over the top and very smooth, the point of the attachment of the silk being lower down on the same side of the kernel as the germ. The two classes thus distinguished may be divided, as with sweet and field corn, into early, medium, and late, and these again into white, yellow, and colored not yellow.

All the varieties of corn cross with each other so readily that it is difficult under ordinary methods to keep a variety strictly to any given type; and so we find frequently that corn sent from different sources under the same name will differ as much as corn from the same source under different names, and that there is room for question as to whether a given lot belongs in this or that group which we class as a variety.

Classified descriptions are given for 15 varieties.

GROWTH AND INCREASE OF DRY MATTER IN CORN, G. E. MORROW, M. A., AND T. F. HUNT, B. S. (pp. 448–450).

This is a preliminary report of a series of observations on the rate of growth of field corn, as determined by measurements and by ascertaining the quantity of dry matter at different dates. The design is to attempt to determine by a series of such observations the relations between growth, both of the whole plant and of its different constituents, and meteorological conditions; and also to help to determine the stage of growth at which the plant has the greatest food value.

The plan adopted is to cut, to measure, and to examine by chemical analysis at stated intervals during the season of growth, the stalks of duplicate or triplicate hills

grown under conditions as nearly similar as possible. The average results of the examination of 6 or 9 stalks will usually give a fairly correct basis for comparison. Work of this nature has been done during 1889 and 1890, under very similar conditions of soil, cultivation, time of planting, etc., but with different varieties.

[In 1889, Edmonds, an early-maturing yellow dent variety, was used; in 1890, Burr's White, a medium-maturing variety.]

A condensed table shows that corn planted the first week of May reached its maximum height (about 10 feet) August 5 in 1889, and July 21 in 1890. In each year a growth of 25 inches was made in 7 days; July 8 to 15, in 1889, and June 23 to 30, in 1890. In the latter year a growth of 48 inches was made in 14 days, from June 16 to June 30. With the average temperature nearly the same, but with 2 inches greater rain-fall in May, 1889, than in May, 1890, the corn made much less growth during the month in the former year. With the average temperature 9 degrees lower and the rain-fall much greater in June, 1889, than in June, 1890, the corn had not half the height at the end of the month in the former that it had in the latter year. With the average temperature nearly the same, but with a much greater rain-fall in July, 1889, than in July, 1890, the growth in the latter year was much more rapid.

The results each year show that the quantity of solid or dry matter in the corn plant is relatively very small in the early stages of its growth. When the corn had reached half its total height it had but about 7 per cent, and when in full tassel, about 36 per cent of its maximum weight of dry matter. When the kernels were in the soft milk stage the plants contained about 62 per cent of the maximum weight of dry matter in 1889 and about 78 per cent in 1890. In 1889 there was a continuous increase of weight, with but a single exception, until the corn was ripe. In 1890 there was greater variation, but the greatest weight was at the final cutting, when the corn was thoroughly ripe. Some of the variations near the close of the season are partly explained by the dropping of the dried leaves and tassels.

In Experiment No. 71 (corn fodder, effect of ripeness) an early-maturing variety of dent corn was planted May 5, 1890. One plat was cut when in the milk or roasting-ear stage, one when the kernels were dented and fairly hard, and one when the corn was fully ripe. The weights for equal plats when thoroughly field-cured were 1,328, 1,710, and 1,810 pounds. The weights of the ear corn from three plats, each one tenth of an acre, were 302.50, 425.75, and 475.25 pounds. The weights were determined of several samples of 100 kernels each from the corn on these three plats, and found to be 19, 29, and 31 grams per 100 kernels.

The indications of these trials clearly are that, so far as quantity of dry matter is concerned, there is a great loss in cutting corn before it is fairly matured, whether it is designed for field-cured fodder or for silage; that to cut it for soiling or summer feeding, even when it is in tassel, is to lose more than half its possible food supply; that to cut it when the kernels are in the soft milk stage causes a loss of one fourth or more of the possible yield of dry matter; that the dry matter of the corn kernels increases relatively more than that of the stalks in the later periods of growth.

Other considerations will greatly affect the decision as to the best time for cutting. This preliminary report does not take account of the digestibility or palatability of the fodder at different stages of maturity, nor of the greater or less degree of loss in curing or from exposure, as affected by cutting at earlier or later stages. In case wet weather follows the cutting, the immature corn would probably be most injured. In some years corn cut when in the milk stage and left in the field in ordinary-sized shocks would become unfit for food. On the other hand, the longer the corn is left uncut the greater the danger of injury from storms or from the loss of leaves, etc. When fed fresh, the immature corn is usually very palatable—much more so than when dried. In some cases, at least, the earlier cut corn fodder is less palatable when dried than is that cut when more mature.

WEIGHT OF EAR CORN PER BUSHEL OF SHELLED CORN, G. E. MORROW, M. A. (pp. 450, 451).

The percentage of water in corn in Central Illinois when husked in the autumn of 1890 was considerably less than in the years immediately preceding. We have found that 70 pounds for the early, 73 for the medium, and 78 for the late-maturing varieties tested at this station was sufficient to produce a bushel of air-dry corn at the last of October.

Tests have been made February 14, 1891, in which a trifle over 65 pounds of Murdock, an early maturing variety, 66.5 pounds of Leaming, less than 67 pounds of Burr's White, and a little over 66 pounds of mixed varieties of yellow dent made 56 pounds of shelled corn. The ears were not especially selected. * * *

When thoroughly air-dry, 12 pounds of cob per bushel, or 68 pounds of good ear corn for 56 pounds of shelled corn, would seem a maximum for any variety suitable to be grown in this latitude. When the ears have been carefully selected, as in selecting corn for seed, less than this should be sufficient. When delivered to the buyer in the ear, there are often many partly shelled ears, inferior ears, some dirt, etc.

No fixed rule can be given for determining the proper weight of ear corn for a bushel of shelled corn soon after husking. The per cent of moisture in both cob and kernel varies greatly in different seasons and in different varieties.

Illinois Station, Bulletin No. 14, February, 1891 (pp. 16).

MILK TESTS, E. H. FARRINGTON, M. S. (pp. 453–467).

Tests of milk of separate cows (pp. 453–460).—The importance is urged of more definite knowledge regarding the milk of each cow of the herd, which the devising of various simple methods for the testing of milk has placed within the reach of every intelligent farmer. The record of two registered cows of the same breed is given from the Annual Report of the Maine Station for 1889, showing wide variations in yield of milk and butter. A report is made of tests of the milk given by each of fifty cows in 24 hours, being a continuation of the work in this direction, reported in Bulletin No. 10 of the station (See Experiment Station Record, Vol. II, p. 211). These fifty cows belonged to four different herds. Tabulated data, showing the yield of milk and of butter fat in 24 hours, date of calving, etc., are given for each animal. In herd A, consisting of thirteen cows, the time since calving was in each case 4 months. The yield of milk in 24 hours varied from 8.25 to 15.25 pounds, averaging 11.5 pounds; and that of butter fat from 0.3 to 0.62 pounds, averaging 0.46 pounds.

The thirteen cows in herd B had all calved within a month. The milk yield for 24 hours ranged with the individual cows from 17.75 to 38 pounds, averaging 25 pounds; and of butter fat, from 0.7 to 1.25 pounds, averaging 0.9 pound. In each herd the cow which gave the most milk produced the largest amount of butter fat, but "the most butter fat was not always produced by the cows giving the most milk. * * * The best cow [of herd B] was 77 per cent better than the one giving the least butter fat on this day, while in the previous comparisons [herd A] the best was over 100 per cent better than the poorest." Wide differences were also noticeable in herds C and D, but as the time since calving was less uniform the comparison is less striking.

Tests made at creameries (pp. 460, 461).—A table shows the pounds of milk and of butter fat (as found by test) brought by each of seventy-eight patrons to two creameries in one day. At creamery A the butter fat in the milk supplied by forty-eight patrons ranged from 3.3 to 5.2 per cent; or to make 1 pound of butter fat, 30.3 pounds of the poorest or 19.2 pounds of the richest milk would be required Milk brought by the thirty patrons to creamery B contained from 3.7 to 6.4 per cent of fat, requiring from 15.6 to 27 pounds of milk for 1 pound of butter fat. A description is given of the method employed at a creamery in De Kalb, Illinois, of paying creamery patrons on the basis of the amount of butter fat in the milk. A report of one creamery for October, 1890, "shows that the patrons who were paid on the test plan received from 93 cents to $1.32 per 100 pounds of milk."

Sampling of milk to be tested (p. 461, illustrated).—An illustrated description of the method of sampling employed at a creamery at De Kalb, Illinois.

Comparison of different milk tests with each other and with the gravimetric laboratory analysis (pp. 462–466).—Notes are given on the Babcock, Patrick brine bath, and the Beimling (Vermont Station) methods of testing milk, and comparisons of the results by these methods and the gravimetric (Adams, sand, and asbestos) methods for twelve samples of whole milk, five of skim-milk, and three of buttermilk. Variations in the results by the three gravimetric methods, amounting in some cases to 0.28 per cent of fat, make the results of the comparative test of these and the simple methods unsatisfactory. The showing for the latter was, in general, quite good.

Device for measuring acid into the test bottles (pp. 466, 467, illustrated).—An illustrated description of an apparatus for conveniently measuring the acid to be used in the test bottles in the Babcock method for testing milk.

CHEMICAL ANALYSES OF "GERM MEAL" AND "OAT-DUST FEED," E. H. FARRINGTON, M. S. (pp. 467, 468).—Analyses of these two feeding stuffs are compared with the average composition of oats, wheat bran, corn meal, and timothy hay. The germ meal, which resembled oats in composition, sold in car-load lots at $16 per ton.

Kansas Station, Bulletin No. 14, December, 1890 (pp. 14).

WINTER PROTECTION OF THE PEACH TREE, E. A. POPENOE, M. A., AND S. C. MASON, B. S. (pp. 81–84).—In view of the difficulty of securing a crop of peaches in Middle and Northern Kansas, owing to the severe cold of winter and the late frosts of spring, the station has made experiments in protecting the trees. In the fall of 1887, after pruning the branches were drawn in toward the main stem and the tree was covered with boughs of evergreen, but this plan did not give satisfactory results. In 1888 the trees were bent down as close to the earth

as practicable, the larger roots on opposite sides of the trunk, preferably north and south, being cut off near the base; and a covering of poor hay and brush was used for protection. The trees thus covered blossomed much more fully than did those left exposed, and the fruit set well, but at the time of ripening a rot attacked all the peach trees and ruined the crop. In 1889 the method of protection used the previous year was tried with the same trees. The results are summed up as follows:

The trees are now [fall of 1890] in good healthy condition. The bearing wood is in a compact head, with no long branches to be broken down by the fruit. The shoots and spurs are at this writing covered with plump fruit-buds. The lateral roots are strong, while those at front and back are no longer an obstacle to the operation of laying down the trees. There was this year a full crop of fruit, and such fine Crawfords, Old Mixons, Smocks, Stumps, Elbertas, Columbias, Bonanzas, and Ringgolds were not to be found in any orchard but our own in this locality, though in some favored stations outside the College farm certain seedling trees were in fruit in a limited way.

We sold most of the product readily on the spot at the rate of 60 cents per basket for the finest early, and 50 cents for the later fruit, the basket being the ordinary 10-pound grape package.

The cost of putting down 71 trees in the fall, including labor and hay bought, with the expense of replacing them in the spring, amounted to about 20 cents per tree, the labor being paid at the rate of 10 cents per hour, and the hay costing $2. The average yield of the trees, accounting for fruit gathered and sold, and allowing by estimate for some stolen, was not far from one half bushel each, leaving, at the prices obtained, a net return of not far from $1.50 per tree.

NOTES ON THE GRAPES IN THE EXPERIMENTAL VINEYARD, E. A. POPENOE, M. A., AND S. C. MASON, B. S. (pp. 85–92).—Brief descriptive notes on 57 varieties.

Louisiana Stations, Bulletin No. 3 (Second Series), (pp. 20).

REPORT OF HORTICULTURAL DEPARTMENT, H. A. MORGAN, B. S. A., AND J. G. LEE, B. S. (pp. 40–59).—This is a catalogue of the fruits and vegetables now under test at the State and North Louisiana Stations, with short notes on 47 varieties of tomatoes, 28 of corn, 15 of water-melons, and 2 of musk-melons grown at the State Station, and on 2 varieties of lettuce, 5 of radishes, 9 of peas, 6 of beans, 1 of onions, 5 of tomatoes, 1 of beets, 4 of cucumbers, 8 of cabbages, 1 of squashes, 4 of corn, 6 of water-melons, 2 of musk-melons, and 21 of strawberries, grown at the North Louisiana Station.

Louisiana Stations, Bulletin No. 4 (Second Series), (pp. 20).

IRISH POTATOES, W. C. STUBBS, PH. D., H. A. MORGAN, B. S. A., AND J. G. LEE, B. S. (pp. 60–81).—Tabulated notes are given on the yields of 10 varieties of potatoes grown in 1890 at the Sugar Experiment Station. It was found that, contrary to the general opinion, Western-grown

potatoes gave better yields than the Boston or Eastern-grown. At the North Louisiana Station four investigations with potatoes were undertaken in 1890: (1) variety tests, (2) size of seed potatoes and whole potatoes *vs.* cuttings, (3) fertilizer experiments, and (4) profitableness of potato raising.

Test of varieties.—Tabulated data and brief descriptive notes are given for 57 varieties. The land used was fertilized with cotton-seed meal 400 pounds, acid phosphate 200 pounds, and kainit 100 pounds per acre.

Six of the varieties yielded over 400 bushels per acre, viz.: Boston Peerless, Vermont Early Rose, Beauty of Hebron, Cayuga, Callum's Superb, and Russett. Eleven gave over 350 bushels, viz.: Parson's Prolific, Enos Seedling, Home Comfort, Late Favorite, Webb's Early, Sylvian, Extra Early Vermont, Dunn's Seed, Early Puritan, Dictator, Platt's No. 5. Thirteen followed with yields over 300 bushels per acre, viz.: Baker's Imperial, Strawberry, Bliss's Triumph, Burbank, Sunset, Great Eastern, English Kidney, Rural Blush, Irish Cup, Scotch B., Dunnmore, James Vick, and Buffalo Beauty. Of the remainder, seven gave less than two hundred bushels per acre. The lowest yield was 170 bushels per acre, the highest 435.

Size of seed potatoes, and whole potatoes vs. cuttings.—Seven varieties were grown in four ways: (1) from whole large tubers, (2) from medium sized tubers, (3) from cuttings of two or more eyes, and (4) from cuttings of one eye. The results, as stated in tables, show that while the larger the seed planted the greater the yield, "the net yield, after deducting seed planted, varied but little. It is doubtful whether on a large scale pieces of potatoes larger than four eyes or smaller than two eyes will be found of the most profitable use as seed."

Fertilizer experiments.—These were made on a loose, gray sand of very poor quality. Nitrate of soda, sulphate of ammonia, cotton-seed meal, acid phosphate, kainit, crushed cotton seed, and green cotton seed were used in various combinations, and all but the first two singly.

The results, as stated in a table, indicate that a mixture of cotton-seed meal and acid phosphate gave the best results; kainit produced no effect; the mineral forms of nitrogen were probably "washed from the soil by very heavy rains of early spring."

Profits in early potatoes.—In order to determine if potatoes can be profitably grown in Northern Louisiana for Northern markets, the product of about an acre of very poor land was shipped to Chicago, where it netted over $50 per acre. "There were produced besides 10 barrels of culls, which were used on the farm. The ground was occupied about 4 months by this crop, which was removed in ample time for a good fall crop."

The bulletin also contains concise statements of the results of potato experiments at other stations and a brief discussion of potato diseases.

Louisiana Stations, Bulletin No. 5 (Second Series), (pp. 15).

SUGAR MAKING ON A SMALL SCALE, W. C. STUBBS, PH. D. (pp. 81–99).—This bulletin was prepared in response to numerous inquiries received from farmers throughout the Gulf States for information regarding sugar making, and is intended for the guidance of those "who grow only patches of sugar-cane and make sugar, sirup, and molasses for home consumption or local use." To make sugar profitable in an extensive way hundreds of acres of cane must be planted, and a costly plant of machinery must be maintained. To make sugar on a small scale requires only "a horse mill, evaporator, and a few boxes capable of holding cane juice—an outfit varying in cost from $50 to $300." The topics treated in this article are the preservation of the cane for seed, methods of planting, varieties, cultivation and manuring, harvesting, and the machinery and processes used in the manufacture of sugar, sirup, and molasses.

Purple or violet and red ribbon or striped cane are the varieties generally planted in the South, but for the higher latitudes, outside the sugar-cane belt proper, the trial of a variety called Japanese or Zwinga is recommended from the experience of the Louisiana Stations. It is a white cane, of good length, but small in diameter, grows well without much attention, rattoons and stools well, and withstands considerable cold. "It is, however, a hard cane, and has not so high a sugar content as the purple or ribbon cane. It is also difficult to clean it for the mill."

For sugar making from sorghum Link's Hybrid is considered by the author to be the best variety.

Experiments with sugar-cane at the North Louisiana Station are briefly reported.

In the fall of 1888 a few hundred stalks of purple cane were purchased and planted. Only a partial stand was obtained and a light tonnage made. This cane was used to plant the crop of 1890. A portion was planted in the fall, and the rest, after being successfully matted, was planted in the spring. * * * An excellent stand was secured. The fall plant came up early, and a part of it gave a large tonnage. The spring plant came up late, and on account of a prolonged drought in July and August never attained a large size. The ground upon which this cane was grown is perhaps the poorest in North Louisiana, and has been in cultivation for over 75 years. It was well prepared and laid off in 5-foot rows, and planted a single running stalk. It was fertilized with a mixture of cotton-seed meal and acid phosphate.

The stubble cane yielded 15.6, the fall plant 16.6, the spring plant 8, and the Japanese cane 10 tons per acre. The crop was made into sugar. The analyses of the juices are stated in tabular form, as well as the amounts of sugar and molasses. Sugar was made at the rate of 1,600 pounds per acre, worth $56 at wholesale, and molasses at 106.6 gallons per acre, worth $37.

Louisiana Stations, Bulletin No. 6 (Second Series), January, 1891 (pp. 43).

FIELD EXPERIMENTS WITH SUGAR-CANE, W. C. STUBBS, PH. D. (pp. 100–142).—These were along the same lines as the experiments with sugar-cane reported in Bulletin No. 20 of the Louisiana Stations (See Experiment Station Record, Vol. I, p. 63), and included investigations on physiological questions, varieties best adapted to Louisiana, and manurial requirements.

Weather report (pp. 102–106).—This includes tabulated monthly summaries of the temperature and rain-fall at the Louisiana Sugar Station from March, 1886, to December, 1890, inclusive, and of the meteorological observations made during 1890; brief notes on the weather of the past 5 years; and a tabulated summary of the temperature and rain fall by seasons for 5 years. In 1890 "the season was favorable throughout to the growth of cane, and hence the large crop was harvested in a very immature condition. Neither the temperature nor rain-fall has been excessive, but well distributed throughout the season, extending well into the fall.

"Taking the table and the seasons, we find that a dry, warm winter, followed by a moderately dry spring, and this in time succeeded by a hot, wet summer, are conditions favorable to maximum growth of cane. It seems too, that a dry, cool autumn, beginning early in September, is necessary to produce a large sugar content. After the cane is laid by, frequent showers of considerable intensity appear highly beneficial."

Distance between cane rows (pp. 107, 108).—Ribbon cane was planted in rows from 3 to 8 feet apart. The yield of cane and the results of analysis of the juice are given in a table. The results in 1890 agreed with those of previous years in favoring a distance between the rows less than the common distance of 7 feet. "Any planter is safe in adopting 5-foot rows, and upon these the 2-horse cultivators can be successfully used."

Part of the cane to plant (pp. 108, 109).—Selected stalks of ribbon cane were cut into two and three parts, and the tops, middles, and butts were planted separately. The results, stated in a table, confirmed previous observations in indicating that the upper part is equal or superior to any other portion of the cane for seed.

Number of stalks of cane to plant (pp. 109, 110).—From one to four stalks of purple cane were planted in each of two series of experiments. "In the first series the entire cane was planted 'uncut,' and in the second the cane was cut in lengths of from 12 to 18 inches." The results stated in a table, indicate, as heretofore, that "with good cane two stalks are sufficient to insure the largest returns." The uncut stalks gave a larger tonnage, and in every case but one a larger sugar content than the pieces of cane.

Plant vs. stubble cane for seed (pp. 110, 111).—In this experiment plant cane was compared with first, second, and third year's stubble. The results, stated in a table, seem to favor stubble cane.

Varieties of cane (pp. 111–128).—It is believed that there are very few really distinct varieties of cane. Very many of the numerous so-called varieties differ very little from each other, and it is probable that in many cases these differences are inconstant or accidental. During the past three years the station has received over one hundred varieties from different parts of the world and of these over seventy have been successfully grown here. The following interesting facts have been brought out:

(1) The facility with which a variety changes its apparent characteristics under changed conditions of soil and climate. * * * This is notably the case with white canes, all having a tendency here to assume more or less a colored appearance. This is partially accounted for by the difference in maturity between the foreign cane received and its progeny here. * * *

(2) Frequently canes of widely different characteristics when first received have, by constant cultivation, gradually gravitated toward each other in general appearance, and to-day it is quite difficult to distinguish between them. This is particularly the case with the lighter-colored varieties.

(3) The gradual diminution in size and increase of sugar content of almost every variety while undergoing acclimation.

(4) The power of resisting the prostrating effects of the storms so usual here in the fall, and which frequently injure seriously our home-grown or acclimated varieties. This property may be greatly modified or perhaps eliminated by acclimation.

(5) The impossibility of determining the value of a cane by a few years of cultivation here. This is rendered more apparent each year. Several canes which were very unpromising the first year or two are by acclimation yearly improving and may ultimately be useful, and *vice versa*.

The station is growing the many varieties now on hand with a two-fold object, (1) to secure a variety adapted to our wants, and (2) to properly classify the varieties and eliminate all closely related subvarieties. Unfortunately for the botany of cane, the nomenclature of varieties is execrable. There are no specific names, common in all countries. The same cane is known in different countries or localities by different names. Hence on receipt of a foreign variety its name gives no indication of its presence already in our collection.

Of the foreign varieties tried several are unworthy of extensive propagation, some are improving yearly under our cultivation and may ultimately become useful by thorough acclimation, while a few are full of promise. There are some who believe it useless to attempt to acclimatize foreign varieties, and think that energy is better expended in improving the purple and striped varieties already well domiciled. While every effort should be made to accomplish the latter, the former, too, is certainly worthy of persistent trial.

Brief descriptive notes are given on 64 varieties; tabulated results of analyses of single stalks of 31 varieties received from Jamaica; the yield and sugar content of 33 other varieties grown at the station and worked up in the sugar-house, and analyses of 23 varieties grown at the State Station at Baton Rouge; and of 22 varieties grown at the North Louisiana Station, at Calhoun.

Manurial requirements of sugar-cane (pp. 123–142).—The problems connected with the use of fertilizers on sugar-cane in Louisiana are discussed. In general the experiments of the past 5 years by the station have indicated that the soils of the State require the application of nitrogen and phosphoric acid to grow large crops of sugar-cane, but that potash can not be profitably used. Cow-peas and cotton-seed meal are chiefly relied on to furnish the nitrogen. But the experiments in Louisiana and Barbadoes point to the fact that a large tonnage of cane is associated with a low sugar content, and it still remains to be determined how to so apply fertilizers as to get the best results in available sugar. Special potash, phosphoric acid, and nitrogen experiments were tried at Audubon Park, where the Sugar Station is now located, for the first time in 1890. The plan followed was similar to that used in previous experiments by the station as recorded in Bulletin No. 20 (See Experiment Station Record, Vol. I, p. 65). The results stated in tables were rightly deemed inconclusive. Experiments in this line will be continued.

Louisiana Stations, Bulletin No. 7 (Second Series), January, 1891 (pp. 24).

REPORT OF LOUISIANA STATE STATION FOR 1890, D. N. BARROWS, B. S. (pp. 143–166).—*Experiments with corn* (pp. 146–152).—These include a test of varieties, and experiments with fertilizers and with methods of planting and cultivation.

Corn, test of varieties.—Tabulated data are given for 12 varieties grown in 1890. During the past 3 years Mosby, Blount's Prolific, and McQuade have been among the most productive varieties at the station. Golden Dent and Young's Hybrid, newly introduced varieties, were the best in 1890.

Corn, experiments with fertilizers.—Various combinations of kainit, muriate, sulphate, and nitrate of potash, acid phosphate, cotton seed, cotton-seed meal, dissolved bone, bone meal, gypsum, nitrate of soda, sal ammoniac, dried blood, and fish scrap were used for Red-Cob Gourd-Seed corn. The results as stated in tables are not conclusive, but hint that phosphoric acid is "the most important element of plant food for corn on these bluff soils."

Corn, methods of planting and cultivation.—McQuade corn was planted on a level plat, 225 by 76 feet, and covered with a smoothing harrow. After the corn was up the harrow was run over the plat twice at an interval of 3 weeks. On half the plat the corn was thinned to 1 stalk to the hill and on the other half to 2 stalks to the hill. After this cotton-seed meal and acid phosphate were applied to half of each portion of the plat representing the two degrees of thickness of planting. The yield per acre where there were 2 stalks to the hill averaged 64 bushels, and where there was 1 stalk to the hill, 42 bushels. The fertilizers produced very little effect.

Experiments with cotton (pp. 152–157).—These included a test of varieties and experiments with fertilizers.

Cotton, test of varieties.—Tabulated data of yields per acre of seed cotton and lint are given for 20 varieties. Climatic conditions materially reduced the yields as compared with those of the previous year. Haggerman, Welborn's Pet, Southern Hope, Okra, and Herling gave the largest yields of lint and seed. "Bolivar County, Peerless, Ellsworth, and T. J. King had virtually matured all their crop by the time of the second picking."

Cotton, experiments with fertilizers.—These were similar to those on corn referred to above, and the results as stated in tables were not at all positive.

Forage crops, grasses, and fruits (pp. 158–161).—Brief notes on a number of varieties of forage plants and grasses under experiment at the station. Hungarian grass and German and Golden millet are thought to be particularly valuable in the rainy climate of the station because they can be cured so rapidly. Texas blue-grass (*Poa arachnifera*) is recommended as able to survive the warm summer of this section, and as affording an excellent winter pasture. All kinds of fruits growing at the station were severely injured by the freezing weather of last March.

Sugar-cane analyses (p. 161).—Tabulated data for analyses of 23 varieties of sugar-cane grown at the station in 1890.

Live stock (pp. 162–164).—The station is keeping Holstein and Jersey cattle to test their adaptability to this section. So far both breeds have done well. A list of 11 breeds of hens under experiment at the station is given.

Tile drainage (pp. 164, 165).—The station is experimenting with tile drainage on about 5 acres of land. The cost of the tiles and laying at intervals of 40 feet on an acre is estimated to be $47.50.

Massachusetts State Station, Seventh Annual Report, 1889 (pp. 333).

REPORT OF DIRECTOR, C. A. GOESSMANN, PH. D. (pp. 9–11).—A brief outline of the work of the station.

FEEDING EXPERIMENTS WITH MILCH COWS, C. A. GOESSMANN, PH. D. (pp. 12–102).

(1) *Relative value of fodder corn, corn stover, and corn silage as compared with English hay; and of corn silage as compared with sugar-beets and with carrots* (pp. 12–47).—This is a record of the fourth year of observation on the above subjects. The present experiment was made with nine grade cows, though not more than six took part at any one time, the plan being as soon as the milk of any animal fell below 6 or 7 quarts per day to substitute a new milch cow in its place. The time, from November, 1888, to May, 1889, was divided into 9 feeding periods. The plan followed was to feed the same quantities of grain (corn meal, wheat bran,

and gluten meal, 3¼ pounds each per day) during each period, and to replace the hay, in separate periods, partly or wholly by one of the following coarse fodders: corn stover, fodder corn, corn silage, carrots, sugar-beets, and rowen. Thus:

Periods I, VI, VIII, grain and hay.
Period II, grain and fodder corn.
Period III, grain and corn stover.
Period IX, grain and rowen.
Period IV, grain, "half ration" of hay, and carrots.
Period VII, grain, "half ration" of hay, and sugar-beets.
Period V, grain, "quarter ration" of hay, and corn silage.

The amounts of the substituted coarse fodders consumed were regulated by the appetites of the animals; the consumption of hay, except when fed alone with grain, was limited as indicated above (quarter, 5 pounds, and half, 10 pounds, rations). The changes from one ration to another were gradual, at least 5 days being allowed for each transition period. The nutritive ratio of the different rations varied from 1:5.13 to 1:6.79. The animals were weighed weekly. The data given include for each animal and in each period the average live weight, food consumed, dry matter in the food, milk produced per day, and dry matter consumed per quart of milk; nutritive ratio of food, average, total, and net cost of food per quart of milk, manurial value of food consumed and average composition of milk; the amount of milk of six cows required to make one space of cream while on each of the coarse fodders; and analyses of the corn meal, wheat bran, gluten meal, hay, rowen, fodder corn, stover, silage, carrots, and sugar-beets fed, with reference to fertilizing ingredients and to feeding value. In calculating the total cost of food consumed corn meal is reckoned at $21.90 per ton, wheat bran at $20.70, gluten meal at $23.40, hay and rowen at $15 each, fodder corn, stover, and sugar-beets at $5 each, silage at $2.75, and carrots at $7. The valuations of the fertilizing ingredients in the food are based on nitrogen at 17 cents, phosphoric acid at 6 cents, and potassium oxide at 4½ cents per pound.

[This value], deducting 20 per cent for the amount of fertilizing constituents lost in the production of milk, is in every instance more than equal to one third of the original cost of the food. In some instances it amounts to more than one half of the original cost of the food consumed.

Net cost of food represents the sum obtained by subtracting 80 per cent of the commercial value of the fertilizing constituents contained in the fodder consumed, from the total cost of the feed. Nothing but the net cost of feed is considered in the discussion of the cost of production of milk and of cream.

The results of this experiment "lead to the same conclusions as our observations in preceding years," and are in brief as follows: In every instance a larger amount of hay was required for the production of 1 quart of milk than was required of either fodder corn, corn stover, or silage containing a like percentage of dry matter, the grain food remaining in all cases the same. The amount of coarse fodder required per

quart of milk was smallest with corn stover. The net cost of food per quart of milk was from one third to one half less with either fodder corn, stover, or silage than with hay. With each animal this cost was the lowest when fodder corn was fed, and in four out of six cases the cost was lower with corn stover than with silage (the silage, however, only partly replaced the hay in the rations, while both fodder corn and stover replaced it entirely). Both sugar-beets and carrots, when fed in place of part of the hay, "almost without an exception, raised the temporary yield of milk, exceeding as a rule the corn silage in that direction."

With both corn silage and roots the best results were obtained when they replaced from one fourth to one half of the full hay ration. "From 25 to 27 pounds of roots, or from 35 to 40 pounds of corn silage per day, with all the hay called for to satisfy the animal, seems a good proportion, allowing the stated kind and quantity of grain food." The influence of the different rations on the quality of the milk "seems to depend in a controlling degree on the constitutional characteristics of the animal. In our case the effect is not infrequently the reverse in different animals on the same diet. The increase in the quantity of milk is frequently accompanied by a decrease in solids."

A short summary is given of experiments with fodder corn, corn stover, and corn silage *vs.* English hay for 4 years (1885–1889). The tabulated data show the principal daily rations fed, and the nutritive ratio and cost of the same; the variations in the daily yield of milk, in the total and net costs of food per quart of milk, and in the amount of dry matter consumed per quart of milk; and the market price, value of manurial constituents, and relative net cost per ton of each of the single feeding stuffs used in the experiments.

"The main interest of our inquiry consists in the successful subtitution, under otherwise corresponding circumstances, of dry fodder corn, corn stover, or corn silage, either partially or wholly, for English hay, as far as net cost of food and quality and quantity of milk are concerned. * * * At present local market prices of feeding stuffs, hay and corn meal are very costly fodder articles, and the same applies to carrots."

(2) *Green crops vs. English hay* (pp. 48–63).—A brief recapitulation is given of comparisons of green vetch and oats, green serradella, and green Southern cow-peas with English hay as food for milch cows, made in 1887 and 1888. In continuation of these experiments six cows were fed in 1889, from June 19 to October 22 (five periods), 3¼ pounds each of corn meal, wheat bran, and gluten meal, together with coarse fodder, consisting in the first and fifth periods of a "full ration" of hay, and in the second, third, and fourth periods of 5 pounds ("quarter ration") of hay and all the green fodder the cows would eat. This green fodder consisted in the second period of vetch and oats, in the third of cow-peas, and in the fourth of serradella. "The amount actually consumed per day varied in the case of vetch and oats from 30 to 55 pounds, of cow-peas from

66 to 84 pounds, and of serradella from 63 to 85 pounds, showing but little preference for one as compared with the others, the difference in the daily consumption of the green fodders being due largely to their variations in dry vegetable matter during the progress of the experiment."

The amount of food consumed per day, dry matter in the same, milk produced, dry matter consumed per quart of milk, nutritive ratio of rations, total and net costs of food per quart of milk, composition of milk, and the live weight are tabulated for each animal by periods; together with analyses of the corn meal, wheat bran, gluten meal, hay, vetch and oats, cow-peas, and serradella fed, with reference to fertilizing ingredients and to feeding value. In calculating the cost of food the following prices were allowed: corn meal $19, wheat bran $18.50, gluten meal $22, vetch and oats $2.75, cow-peas $3.14, serradella $3.16, and hay $15 per ton. The same allowance was made for the fertilizing ingredients in the food as in the previous experiment.

"The results obtained fully sustain the conclusions presented in our previous reports." These are in brief as follows: A smaller amount of dry matter sufficed for the production of one quart of milk where a part of the hay was substituted by the green fodders than where the full ration of hay was fed, "indicating a superior nutritive value of the former as compared with the latter. The milk was in every instance increased by changing from a hay ration to a green-fodder ration. The quality of the milk was but slightly altered; the solids were in some cases slightly increased and in others they were slightly decreased."

"The net cost of food for the production of milk was in every instance less in case of the green-fodder rations than with the hay ration. The weight of the animals in most cases increased towards the close of the experiment."

(3) *Cost of food for the production of milk* (pp. 64–72).—A record is presented of twelve grade cows which have been used in various experiments at the station since 1884, primarily to test the effect on the cost, quantity, and quality of the milk, of substituting corn fodder, corn stover, silage, and root-crops in part or wholly for hay. The coarse fodders fed at different times were hay, dry fodder corn, corn stover, silage, roots, various dried fodder crops, green fodder crops, as vetch and oats, barley, vetch, serradella, and cow-peas; and the grain food consisted variously of corn meal, corn-and-cob meal, wheat bran, and usually gluten meal. "Twenty per cent loss of the fertilizing constituents contained in the food has been allowed for the amount sold with the milk. The period of observation varied, in the case of different cows, from 261 to 747 days; the average daily yield of milk per head for the whole period of observation varied from 7.7 to 12.4 quarts."

The tabulated data include the history of each cow, milk yield, live weight, amount of each kind of food consumed, local value of the materials fed per ton, value of the fertilizing ingredients in the same, the total value of the milk produced by each cow at 3 cents per quart,

total and net cost of food, first cost and selling price of the cow, the total amount received above the net cost of food and of cow, and the averages for the twelve cows. The average amount received (in cash and in manure) above the net cost of food and of cow was 12.33 cents per day; the average cash receipts were 3.52 cents; and the calculated value of the manure (less 20 per cent), 8.81 cents per day. The largest total receipts were 15.97 cents per day, and in the case of one cow, which during 331 days averaged only 7.7 quarts of milk per day, "there was an actual loss of 1.2 cents per day. * * * The total value received above net cost of food and of cow depends in every instance in a controlling degree on the manure obtainable. In No. 8 it prevents a serious loss, while in No. 4 it represents practically the entire gain; in some instances it amounts to from three fourths to two thirds, and in none as low as one half of the total value secured."

The author emphasizes the fact that, "as the value of the manure depends in a controlling degree on the amount of fertilizing constituents contained in the food, it becomes apparent that this point ought to be seriously considered when selecting suitable fodder articles for a remunerative daily diet of dairy cows; * * * [and that] the most serious attention ought to be bestowed on collecting and preserving the manurial refuse obtained in connection with the production of milk, for it depends largely on a judicious management of that matter how much of the stated manurial value will be actually secured." He further states that, "judging from our own conditions, a cow whose total milk record averages not more than 7 to 8 quarts per day, promises to prove a better investment when prepared for the meat market" than when kept for milk to be sold at the above-stated price of 3 cents per quart.

(4) *Creamery record of the station during* 1887, 1888, *and* 1889 (pp. 73–84.)—"The subsequent communication contains a discussion of our creamery record, which covers, to a considerable extent, the time when the above-mentioned milk record was obtained. The milk was weighed at the station and the cream raised and measured by means of a Cooley creamery apparatus. The value of cream is that allowed us from month to month by our local creamery association.

"Our financial results are based on the local cost of food alone [making the same allowance for fertilizing constituents as stated above], and do not consider interest on investment, and labor involved." Tabular statements are made for the 3 years by months, of the total amounts of the different fodder articles consumed by the station herd, the rations fed daily, nutritive ratio of the same, and the total net cost of food; the average composition of the milk, the value of the cream at creamery prices, and the cost of the skim-milk allowing 3 cents per quart for whole milk. An analysis shows the average percentages of the fertilizing constituents of cream.

The monthly averages for each year of milk and cream produced by the station herd, the cost of food, receipts for cream, and the cost of the skim-milk with whole milk at 3 cents per quart, are given below.

Average per month.

Averages—	Amount of milk produced.	Amount of cream produced.	Total cost of food consumed.	Net cost of food for production of cream.	Amount received for cream.	Skim-milk produced.	Cost of skim-milk per quart (with whole milk at 3 cents per quart).
	Quarts.	*Quarts.*				*Quarts.*	*Cents.*
For 1887	1752.2	269.3	$40.60	$21.52	$32.57	1,482.9	1.32
For 1888	1666.2	285.8	38.73	18.49	36.11	1,380.4	1.00
For 1889	1862.3	330.4	44.62	21.24	38.31	1,531.9	1.14

The net cost of food in this case refers to the total cost, less the value of the fertilizing constituents contained in the cream, which was calculated from the average of several analyses. "In selling cream much less fertilizing constituents are lost to the farm than in selling the whole milk. * * * The cost of skim-milk varied considerably during different months of the year, mainly on account of the changes in the valuation of the cream. * * * The feeding value of skim-milk containing 9.5 per cent solids, as compared with whole milk, is stated by good authority to be as 3.1 to 4. On this basis, with whole milk selling at 3 cents per quart, skim-milk would be worth 2.33 cents. The feeding value of skim-milk, estimated on the customary basis of 4.33 cents per pound of digestible nitrogenous substances and fat, and .9 cent for non nitrogenous substances, would amount, per gallon, to 1.91 cents."

(5) *Some facts concerning two creameries* (pp. 84–102).—This is mainly a statement of the number and breed of cows kept, the rations fed, and the cream produced by each of 193 patrons of two creameries, and a statement of totals and averages for the whole number. Analyses are also given of numerous samples of butter and cream from each creamery, analyses of cream from the station dairy, and a summary of the butter and cream analyses.

FEEDING EXPERIMENTS WITH PIGS, C. A. GOESSMANN, PH. D. (pp. 103–123).—A short discussion of the feeding experiments with pigs made at the station since 1884, including a tabulated summary of the results; and a report of the tenth experiment in this line, made in 1889. The latter was made with seven grade Chester White and Berkshire pigs, weighing from 14 to 23 pounds each at the beginning of the experiment, and extended from April 23 to August 28, 127 days. It differs from the previous trials mainly in the substitution of barley meal for the corn meal. About 5 quarts of skim-milk daily were consumed by each pig during the whole trial. Two ounces of barley meal added to each quart of skim-milk fed, supplemented as needed by a mixture of two weight parts of gluten meal and one of wheat bran, made up the ration

till the end of the second month of the trial. After that the same quantity of skim-milk (5 quarts daily), and a mixture of four weight parts of barley meal and one each of gluten meal and wheat bran were fed. During the first period (live weight 20 to 90 pounds) the nutritive ratio averaged 1 : 2.95; during the second (live weight 90 to 130 pounds), 1: 4.20; and during the third (live weight 130–200 pounds) 1 : 4.61.

The tabulated results show the average of the daily rations fed for each pig, the total amount of food consumed, the total and net cost of the same, the gains in live and dressed weight, dry matter consumed per pound of dressed pork, and cost of same; a general summary for the seven pigs; and analyses of the skim-milk, barley meal, wheat bran, and gluten meal with reference to fertilizing and food constituents. The calculations of total cost of food are based on barley meal at $30, wheat bran at $18.50, and gluten meal at $22 per ton; and in calculating the net cost, 30 per cent was deducted from the total value of the fertilizing constituents of the food. The total cost of the food for the seven pigs was $57.26; the value of the manure (making the allowance as stated above) is estimated at $16.08. As 959.8 pounds of dressed pork were produced, the net cost of food was 4.29 cents per pound of dressed pork; or leaving the value of the manure obtainable out of the calculation, as is often done in reporting feeding experiments, the cost of food would be 5.97 cents per pound of dressed pork. This difference of 1.58 cents per pound of dressed pork indicates the importance of the manurial factor in considering the profits of pig feeding. The dry matter consumed per pound of dressed pork varied in this experiment from 3.40 to 3.81 pounds, as compared with from 2.61 to 3.17 pounds in the previous experiment, in which corn meal was fed in place of barley meal, and which was made at the same season of the year. "The results apparently pointed toward a higher nutritive effect of the corn meal, as compared with that of barley meal, under conditions like ours. The final decision in this direction will be left to further trials."

The author draws the following conclusions from the results of the ten pig-feeding experiments made by him since 1884:

(1) Begin as early as practicable, with a well-regulated system of feeding. During the moderate season, begin when the animals have reached from 18 to 20 pounds in live weight; in the colder seasons, when they weigh from 25 to 30 pounds.

(2) The food for young pigs during their earlier stages of growth ought to be somewhat bulky, to promote the extension of their digestive organs, and to make them thereafter good eaters. A liberal supply of skim-milk or buttermilk, with a periodical increase of corn meal, beginning with 2 ounces of corn meal per quart of milk, has given us highly satisfactory results.

(3) Change the character of the diet at certain stages of growth from a rich nitrogenous diet to that of a wider ratio. * * * Begin, for instance, with 2 ounces of corn meal to 1 quart of skim-milk; when the animal has reached from 60 to 70 pounds use 4 ounces per quart; and feed 6 ounces of meal per quart after its live weight amounts to from 120 to 130 pounds. The superior feeding effect noticed in the case of one and the same diet during the earlier stages of growth will not infrequently be found to decrease seriously during later stages. * * *

(4) To go beyond from 175 to 180 pounds is only advisable when exceptionally high market prices for dressed pork can be secured. The quality of the meat is also apt to be impaired by an increased deposition of fat. The power of assimilating food and of converting it in an economical way into an increase of live weight, decreases with the progress of age.

(5) It pays well, as far as the cost of food is concerned, to protect the animals against the extremes of the season. Feeding experiments carried on during moderate seasons are more profitable than those carried on, under otherwise corresponding circumstances, during the winter season.

FODDER ANALYSES, C. A. GOESSMANN, PH. D. (pp. 124–147).—Analyses of the following feeding stuffs, made during the year (1889) are given: corn meal, wheat bran, gluten meal, old and new-process linseed meal, "fine feed," barley meal, white soja bean, black soja bean, soja bean (entire plant), corn husks or chaff, corn germs, low meadow hay, corn stover, silage, barley and oat chaff, Spanish or long moss (*Tillandsia usneoides*), palmetto root, and samples of corn, together with the fertilizing ingredients of the new and old-process linseed meal, black and white soja beans, soja bean (entire plant), barley and oat chaff, Spanish moss, palmetto root, and corn (kernels).

In presenting these analyses, it seems but proper to call the attention of farmers once more to a careful consideration of the following facts:

The composition of the various articles of food used in farm practice exerts a decided influence on the manurial value of the animal excretions. The more potash, phosphoric acid, and in particular, nitrogen, a fodder contains, the more valuable will be, under otherwise corresponding circumstances, the manurial residue left behind after it has served its purpose as a constituent of the food consumed. * * * The higher or lower commercial value of the manurial refuse left behind decides the actual or net cost of a feeding stuff. * * *

It needs no further argument to prove that the relations which exist between the composition of the fodder and the value of the manure resulting deserve the careful consideration of the farmer.

FIELD EXPERIMENTS, C. A. GOESSMANN, PH. D. (pp. 148–194).

(1) *Influence of nitrogen on the yield and general character of the corn crop* (pp. 148–155).—A report is given of an experiment with corn on 11 tenth-acre plats, all of which received like amounts of potassium oxide and phosphoric acid, and 7 of which received either dried blood, sulphate of ammonia, or nitrate of soda in amounts furnishing the same quantities of nitrogen. Three plats received no nitrogenous fertilizers, and one received barn-yard manure. Data are given relative to the height of the crop at different dates, the yield of stover and ears, and the percentage of well-developed and undeveloped ears on each plat. The crop on the plats receiving no nitrogen was of a light-green color, and "during the first half of the season the same feature was noticeable to some degree on the plats receiving sulphate of ammonia. Upon the remaining plats the color was deep green, indicating a vigorous growth. * * * Not less noticeable is the difference in the character of the final crop. Those plats which received no nitrogen in the fertilizer applied produced not only by far the smallest

quantity of ears, but also the smallest number of well-developed ears. The yield in corn stover, on the other hand, is in two of these cases at least equal to the highest on any of the other plats."

The experiment is to be continued.

(2) *Influence of fertilizers on the quantity and quality of prominent fodder crops* (pp. 156–167).—Notes on Kentucky blue-grass, Bokhara clover, and sanfoin, raised on fertilized and on unfertilized plats, and on Red-Cob Ensilage and Clark corn, meadow fescue, medium red clover, and alsike clover, raised on fertilized plats.

Analyses with reference to both the food and the fertilizing constituents are given for Italian rye-grass, alsike clover, medium red clover, mammoth red clover, alfalfa, and soja bean (entire plant) raised in 1888.

(3) *Experiments with field and garden crops* (pp. 168–188, illustrated).—Notes on the following crops raised in 1889: American ruta-bagas, Lane's and Saxony sugar-beets, Danvers carrots, Erfurt Earliest and Early Snowball cauliflowers, Haines No. 64 tomato, Honduras, New Orange, Kansas Orange, Price's New Hybrid, and Early Tennessee sorghum, Bokhara clover (*Melilotus alba*), *Melilotus cærulea*, *Lotus villosus*, *Pyrethrum roseum*, sulla (*Hedysarum coronarium*), peas, Dwarf Lima beans, early cow-pea, black soja bean, blue lupine, cow-pea, horse bean, Japan clover (*Lespedeza striata*), Chapman honey plant, New Japanese buckwheat, common barley, hulless black barley, Red-Cob Ensilage and Minnesota King corn, Beauty of Hebron potatoes, Hargett's White, Improved American, and Connecticut Valley oats, and Russian rhubarb.

Analyses are given showing the food and the fertilizing constituents of teosinte (*Euchlæna luxurians*), *Lotus villosus*, sulla, hairy vetch (*Vicia villosa*), Bokhara or sweet clover, *Melilotus cærulea*, Danvers carrots, Danvers carrot tops, beets, sugar-beets, potatoes, and American ruta-bagas. The results are also given of determinations of the sugar in five varieties of sorghum, and a table showing the loss in weight of two potatoes kept in a dry cellar from September 26 to April 9.

(4) *Experiments with green crops for summer feed for milch cows* (pp. 189–194).—Notes on the crops of vetch and oats, serradella, and Southern cow-peas raised at the station for green fodder.

REPORT OF VEGETABLE PHYSIOLOGIST, J. E. HUMPHREY, B. S. (pp. 195–230, illustrated).—This includes "(1) a general account of fungi, with special reference to those which cause diseases of cultivated plants; (2) a report on studies of the potato scab carried on during the year; (3) notes on various diseases of plants, which have been more or less prevalent on the station farm the past season; (4) notes on specimens from other sources, referred to the station for examination and report."

Potato scab (pp. 214–223).—In a field in which the scab had appeared for several years experiments were made along the following lines: (1) effects of deep *vs.* shallow planting; (2) susceptibility to attack of

light and dark-skinned varieties; (3) barn-yard manure *vs.* commercial fertilizers; (4) effect of tobacco dust in drill; (5) scabby *vs.* smooth seed. The quality of seed, variety of potato, method of manuring and planting, and amount of scab on the crop are tabulated for each of 28 plats. The results are summarized as follows:

(1) Deep planting appears to tend to diminish the development of scab, though further experiments in this direction are very desirable. (2) While the very dark potatoes were wholly free from scab, little or no difference was to be noticed in the susceptibility of the three light varieties planted; it is to be regretted that none of the best red varieties were available for the comparison. (3) The potatoes raised on barn-yard manure were markedly more scabby and more deeply scabbed than the rest. (4) Tobacco dust in the drill had no appreciable effect in increasing or diminishing the scab. (5) Scabby seed produces a crop neither better nor worse than that grown from smooth potatoes. None of these results are new, but they may serve as further material on which to base general conclusions, and as confirmatory of the results of most previous similar experiments. But all such results are comparatively without significance so long as the cause of the trouble remains unknown, and we are as much as ever in the dark so far as any basis of rational experimentation or treatment is concerned; therefore the most attention has been given to the study of the development of the scab.

Observations on the development of the scab indicated that there were "superficial" and "deep" forms of the disease, but no organism was discovered as its cause. The forms of scab described by European writers are discussed and illustrated in comparison with those examined at the station.

Fungous diseases on the station farm (pp. 223–227).—Notes on the smut of barley and oats (*Ustilago segetum*, Pers.), spot disease of beets (*Septoria betæ*, West, and *Cercospora beticola*, Sacc.), and rot of potatoes (*Phytophthora infestans*, De B.).

Notes on material referred to the station (pp. 227–230).—Brief notes on a fungus found in a cellar, black spot of rose leaves (*Actinonema rosæ*, Fr.), and a disease of cucumbers caused by nematodes.

SPECIAL WORK OF THE CHEMICAL LABORATORY (pp. 231–313).

(1) *Commercial fertilizers* (pp. 232–282).—General remarks on commercial fertilizers and their inspection, the trade values of fertilizing ingredients for 1889, the text of the Massachusetts fertilizer law, and list of licensed dealers; and the analyses of 138 samples of licensed fertilizers, including compound fertilizers, bones, tankage, ground fish, cotton-hull ashes, and nitrate of soda. Besides these, the analyses are given of numerous materials sent to the station for examination, among which are wood ashes, cotton-seed hull ashes, cotton-seed meal, sulphate and muriate of potash, gypsum, lime, South Carolina phosphate, Mona Island guano, dissolved bone-black, bone coal, ground bones, dried blood, sulphate of ammonia, nitrate of soda, saltpeter waste, wool waste, "mud crab," tobacco dust, gluten meal, linseed refuse, cotton-seed fertilizer, oak leaves, chaff from grain elevator, jute waste, hemp waste, cranberry vines, salt hay, barn-yard manure, silage liquor, "nicotinia," hellebore, "peroxide of silicate," and 74 samples of well-water.

(2) *Compilation of analyses made at Amherst, Massachusetts*, 1868–1889 (pp. 283–313).—This includes numerous analyses of chemicals, refuse salts, ashes, guanos, phosphates, refuse substances and animal excrement used for fertilizing purposes; of green fodders, hay, dry coarse fodders, roots, grain, flour meal, by-products, and refuse, with reference both to their feeding value and to their fertilizing constituents; of fruits, as apples, pears, cranberries, peaches, grapes, strawberries, currants, asparagus, and onions; of sugar-producing plants, as beets, sorghum, Northern sweet-corn, musk-melons, etc.; and of dairy products, including milk, skim-milk, cream, butter, cheese, and dairy salt.

METEOROLOGY (pp. 314–319).—The tabulated data include a meteorological summary for each month of the year (1889), miscellaneous phenomena, and the average temperatures for December, January, and February, and for June, July, and August in each year since 1836.

Massachusetts Hatch Station, Third Annual Report, 1890 (pp. 13).

An outline is given of the work in the several departments of the station. In meteorology "special study has been made of solar and lunar halos and coronæ, and their appearance, as precursors of coming storms. A series of experiments has been carried on for some months for the purpose of ascertaining the effect of dynamical electricity on the growth and development of vegetation also the effect of incandescent electric light on plant development, the results of which will appear later in the form of a bulletin."

The electrograph recently purchased for the station (See Experiment Station Record, Vol. II, p. 305), and thought to be the only complete instrument of the kind in this country, is described in detail, with illustrations.

Massachusetts Hatch Station, Meteorological Bulletin No. 26, February, 1891 (pp. 4).

A daily and monthly summary of observations for February, 1891, made at the meteorological observatory of the station, in charge of C. D. Warner, B. S.

Michigan Station, Bulletin No. 70, January, 1891 (pp. 41).

VEGETABLES, VARIETIES AND METHODS, L. R. TAFT, M. S.

Beans (pp. 3–7).—Tabulated and descriptive notes on 51 varieties.

The following short list of varieties will prove satisfactory for home or market use: *Wax beans*—Cylinder Black Wax, Yosemite, Mammoth Wax, and Pinkeye Wax. *Green-podded beans*—Paris Canner, Ne Plus Ultra, Refugee, and Sion House. *Field beans*—Aroostook, Burlingame, Snowflake, and Jack Hatt No. 1½.

Beets (pp. 7, 8).—Tabulated and descriptive notes on 9 varieties.

Cabbages (pp. 8, 9).—Tabulated notes on 27 varieties. There was a striking correlation between the time of germination, period of vegetation, and vigor of plants.

From this year's trial our list of 4 varieties for a succession would be Reynolds's Early Summer, All Head or All Seasons, and Premium Flat Dutch. Market Gardener, Hard Head, and Deep Head are also good sorts to follow Early Summer. Diamond does not make a very worthy showing. Marvin Savoy is the best of its class, and Red Drumhead is also desirable.

Sweet-corn (pp. 10–12).—Tabulated and descriptive notes on 25 standard new varieties.

Of the extra early varieties there was no appreciable difference in time of ripening of Cory, Harbinger, Marblehead and No. 48 from Salzer, and following very closely came Burbank, Crosby, Minnesota, Ford, Leet, Pee and Kay, Perry and Shaker.

Amber Cream, Everbearing, Guaranty, Honey, Maule's XX, Old Colony, Concord, and Stabler would be classed as intermediate, and Late Mammoth, Gold Coin, Shoe-peg, and Stowell as late sorts.

For a succession, the choice would be Cory or Marblehead, Crosby, Concord, Stabler, and Gold Coin.

Cucumbers (p. 12).—Tabulated notes on 9 varieties. Boston Pickling and Parisian are recommended for pickling; Long Green and Perfection for table use. A half teaspoonful of turpentine to a pail of ashes, applied every two or three days, kept away the striped beetles.

Lettuce (pp. 13, 14).—Tabulated notes on 32 varieties. Grand Rapids, Chicago Forcing, and Arlington Tennis Ball are especially recommended for forcing.

For hot-bed varieties in addition to the Chicago, Black-Seeded Simpson, Curled Simpson, Hanson, Blonde Blockhead (practically indentical with Hanson), and Sugar Loaf will do well.

For the cold frame and the open ground for spring use, the hot-bed kinds did well, as did Chartier (Early Prize seems identical), which is an excellent variety, with the wrinkled edges of its leaves tinged with red. All Heart would be a splendid lettuce were it not for its tendency to rot.

Of the summer varieties, All the Year Round, Everlasting, No. 21, and Salamander, (all much alike) are excellent, as are Marblehead, Mammoth and Sunset, which also seem identical. The Cos varieties could not be distinguished.

Peas (pp. 14–16).—Tabulated notes on 54 varieties. The 12 extra-early sorts tried were practically identical. In such a case "more depends on the character of the strain than on the name of the variety under which it is obtained."

The Quantity and Advancer were most productive among the second early sorts, while Quality, Profusion, Pride of the Market, Midsummer, Horsford's Market, and Satisfaction follow closely.

As the varieties in this group are more productive, and generally of better quality than those of the extra-early sorts, it is only advisable to plant enough of the early kinds to bridge over the week or ten days before the Advancer and others of its class are ripe.

Among 18 late kinds, the Everbearing was very productive, followed by Stratagem, Abundance, Forty-Fold, Yorkshire, and John Bull.

Peppers (pp. 16, 17).—Tabulated and descriptive notes on 12 varieties.

Potatoes (pp. 17–29).—The experiments here reported are a continuation of those recorded in Bulletin No. 57 of the station (See Experiment Station Record, Vol. II, p. 58).

Test of varieties.—Tabulated data are given for 107 varieties, with descriptive notes on 32 varieties grown in 1890, the other 75 having been described in Bulletin No. 57 of the station. Among the most productive early varieties in 1890 were Temple's No. 4, Early Ohio, New Queen, Early Maine, Early Puritan, Putnam's Early, and Timpe's No. 6. Of the varieties ripening about August 1 are Clark's No. 1, Burpee's Extra Early, Dandy, Delaware, Hebron, Early Oxford, Faust's 1889, Fort Collins No. 83, Gregory No. 2, Ideal, Lee's Favorite, New Queen, Queen of the Valley, Thorburn, Gregory No. 1, Morning Star, June Eating, and Putnam's New Rose.

All but six of these varieties were grown last year, and, as confirming the accuracy of the test, it may be noted that every one of the above old sorts was in the selected list of last year. * * * Of the late sorts, White Elephant and Summit were most productive, with Copper Mine, Brownell's Winner, Bannock, Empire State, and Nameless No. 2 not far behind. Red Star, Arizona, President Lincoln, and Dakota Red were also productive. * * * The wild Mexican variety has been grown here for a number of years and has greatly increased in size and yield. The eyes are rather deep, and it is too coarse to be a valuable variety. The *Solanum jamesii* has shown itself much less susceptible to improvement, and we have been able to detect no increase in the size, which is about three fourths of an inch in diameter.

Change of seed; seed ends for planting.—Experiments here reported imply that a change of seed about every 3 years is desirable. The results of experiments in 1889 and 1890, as summarized in this article, indicate that the seed ends of potatoes are as good for seed as the middle portion, weight for weight, and better than the stem ends.

Quantity of seed.—To get light on the proper distances for planting potatoes in the row, single eyes, quarters, halves, and whole tubers were planted at intervals of from 1 to 3 feet. The results, as tabulated, led to the opinion that under the conditions obtaining in these experiments—

Single eyes and quarters of medium-sized potatoes may be placed in drills from a foot to 15 inches apart; when halves are used the distance may be increased to 2 feet, and when whole tubers of medium size are planted they may be placed at from 2½ to 3 feet, and thus admit of cultivation both ways. In each case these are intended as maximum distances. This will require from 12 to 15 or perhaps 20 bushels of seed potatoes per acre. With well-prepared and thoroughly drained soil and in favorable seasons the smaller amount might be somewhat diminished with profit, but for the average planter and in average seasons the largest would prove best in the long run.

In 1889 two series of experiments were made regarding the amount of seed to use and the method of cutting it. In 1890 these experiments were repeated with three varieties of potatoes. The results are reported in tables. In one experiment sixty-six potatoes of each variety were so divided that halves, quarters, eighths, and single eyes from the same potatoes were planted in each case, along with whole potatoes.

The results show that the total yield gradually decreases as the amount of seed is lessened. The quantity of small tubers decreases even faster, however, so that the yield from the halves and quarters is larger than from the whole tubers or single eyes. The quantity of seed used in whole tubers is sixteen times as great as with single eyes, and after deducting the seed used the net results are in favor of eighths (8 bushels of seed), and quarters (16 bushels per acre). If the season had not been so dry the halves and whole tubers would have developed a larger per cent of their small tubers, and the results would have appeared much more favorable to them. * * *

Last year the potatoes used for seed averaged somewhat smaller than those for this year's trial, and the halves at the rate of 20 bushels per acre made the best showing. Under favorable conditions we think that this amount of seed will be most profitable for the ordinary grower.

In the other experiment not only the amount of seed was considered, but also the following questions: "(1) Is the half of a whole potato better than a small potato, the weight of the half being equal to that of the whole tuber? (2) Can tubers just below the merchantable size be profitably used for seed purposes?"

In 1890, as in the previous year, the largest market yield was obtained with from 13 to 27 bushels of seed per acre, the largest net yield being from 13.7 bushels.

It also appears that halves are better than whole tubers of the same weight, and a natural conclusion from this is that a whole small potato is not as good as the half of a potato twice as large. As a matter of economy it is a question whether it is best to feed these potatoes of about the size of a hen's egg to stock, and plant only large merchantable tubers, or to plant the small potatoes.

In case one must purchase seed potatoes at a high price, it might yield as large net returns to plant small ones, if they are of good varieties, but in this case the practice should not be kept up year after year.

Depth of planting.—The tabulated results of planting 3 varieties of potatoes at depths of from 1 to 5 inches seem to favor shallow covering, the best yields being from depths of 1 and 2 inches.

Effects of fertilizers.—In fertilizer experiments on potatoes reported in a table, ground bone, muriate or sulphate of potash, and sulphate of ammonia or nitrate of soda, in different combinations, stable manure, and wood ashes were compared with no manure on 16 plats. The crop was a very uneven one, but the indications were that commercial fertilizers would not give a sufficient increase of yield to warrant their use where stable manure can be obtained for the hauling. Wood ashes, if easily obtained, would be profitably used on potatoes and other crops.

Radishes (pp. 29–31).—Tabulated notes on 38 varieties. The following are recommended: *for forcing*—Cardinal Globe, French Breakfast, Forcing Nonpareil, White Turnip, Eldorado; *for summer use*—Wood Frame, Scarlet Short-Top, Chartier, Celestial, Strasburg.

Squashes (pp. 31, 32).—Tabulated and descriptive notes on 10 varieties.

Tomatoes (pp. 32–41).—Tabulated data for 78 varieties and descriptive notes on 34 varieties. All but 9 of the varieties recorded have

been grown at the station more than one year and were described in Bulletins Nos. 31, 48, and 57 (See Experiment Station Record, Vol. I, p. 89, and Vol. II, p. 61).

In 1890 the earliest varieties were Advance, Prelude, Earliest, Keyes, King of the Earlies, Hathaway, Atlantic.

Of the second early varieties, Haines, King of the Earlies, and Victor (Canada) were most productive. Advance and Hathaway will also give satisfaction.

The Victor was obtained 4 years ago from Germany, and by careful selection the form has been much improved.

Of the red varieties for the main crop, the Ignotum, Cumberland Red, Red Cross, Puritan, and Red Mikado were most productive. Perfection, Optimus, Nichols, Volunteer, Red Apple, Belle, and Matchless are all valuable. The Mikado (Turner), Beauty, Acme, and Potato Leaf were best of the purple varieties, and Sunset and Golden Queen of the yellow sorts.

Effect of using seed from first ripe fruit.—Experiments in this line in 1888 and 1889 were reported in Bulletins Nos. 48 and 57 of the station (See Experiment Station Record, Vol. I, p. 90, and Vol. II, p. 61).

[In both these years] a slight gain in the earliness of the crop was noticed, but it was observed that while this gain was considerable in the case of varieties of the angular type, it became a loss when the smooth apple-shaped sorts were considered. In 1890 the results show, as an average of 15 varieties, that the plants grown from early selected seeds gave ripe fruits in $143\frac{4}{5}$ days, while those from the main crop were $145\frac{1}{15}$ days, a difference of $1\frac{1}{3}$ days in favor of early selected seeds. As in previous years, the angular sorts show a marked difference, while in the apple-shaped sorts there is, if anything, a slight average loss in earliness.

Taking the number of ripe fruits up to September 10, we find an average gain of four fruits to the plant by early selection.

Missouri Station, Bulletin No. 13, January, 1891 (pp. 19).

REPORT OF DEPARTMENT OF HORTICULTURE, J. W. CLARK.

Meteorology.—Tabulated records of temperature and rain-fall for the months from April to September, 1890, inclusive.

Spraying experiments.—London purple and Paris green were successfully used for the codling moth (*Carpocapsa pomonella*), Paris green combined with the Bordeaux mixture for the codling moth and apple scab (*Fusicladium dendriticum*), and the Bordeaux mixture for the black rot of grapes (*Læstadia bidwellii*).

Tests of varieties.—*Strawberries.*—Tabulated data are given for 59 varieties of strawberries fruited in 1890, and 21 planted in 1890, with brief descriptive notes on the varieties yielding fruit. "The ten most profitable varieties fruited the past season were Haverland, Warfield's No. 2, Lady Rusk, Crescent Seedling, Cumberland, Crawford, Bubach No. 5, May King, Mt. Vernon, and Parry." *Raspberries.*—Tabulated data for 10 cap and 7 red varieties, with brief descriptive notes for 16 varieties. *Blackberries.*—Tabulated data and descriptive notes for 16 varieties. *Tomatoes.*—Tabulated data for 12 varieties. *Peas.*—Tabulated data for productiveness and earliness of 45 varieties. "The

earliest and most productive varieties were First and Best, Henderson's First of All, American Wonder, and Blue Beauty." *Potatoes.*—Tabulated data for 28 varieties grown from home and Northern seed, and 99 varieties planted April 21 and May 26. Among the 12 most productive varieties in 1889 and 1890 were Prince Edward Island Rose, Beauty of Beauties, Early Sunrise, Thorburn, and Dictator.

New York State Station, Eighth Annual Report, 1889 (pp. 424).

REPORT OF DIRECTOR, P. COLLIER, PH. D. (pp. 6–51).—Brief remarks, mostly popular in their nature, are made on the work undertaken by the station in collecting statistics from the farmers of New York, regarding their dairy stock, rations fed, cost of rations, milk produced, etc. (See Bulletin No. 17, new series, of the station, or Experiment Station Record Vol. I, p. 267); on the experiments commenced to test different breeds of dairy cows (See Bulletin No. 18, new series, of the station, or Experiment Station Record Vol. I, p. 269); on the function of food, experiments in feeding cattle, the value of a manure platform, farm buildings, chemical control of fertilizers, sorghum for forage and sirup, grasses, bulletins, correspondence, a food exhibit by the station, and gifts to the station.

The author advocates the establishment of a dairy school in which "there should be given instruction only in those technical branches directly relating to the science and practice of dairying;" and also of branch stations in different sections of the State. "It would seem that as many as ten branch stations could find profitable employment in the solution of the numerous problems which are presenting themselves in the many and various fields of agricultural industry in our Empire State."

In remarks on the changes in yield and value of farm crops in New York, the average yield per acre of the leading crops of the State, market value and percentage of changes in yield and market value are tabulated for the periods 1862–70, 1871–79, and 1880–87, together with the amount of each of these crops which may be bought for $10, and the amount and value of the fertilizing constituents in the same.

So far as crop production is concerned, there is little cause for alarm over diminished yield, for if we consider our five principal crops, corn, wheat, oats, potatoes, and hay, the aggregate value of which is 92 per cent of the total value of our leading farm crops, we shall find that these five crops have fallen off in their average yield but 1.6 per cent in the second period over what it was in the first period, and the average yield of the third period was within 8.8 per cent of what it was in the first; and this diminished yield is perhaps largely due to less careful cultivation, which the low prices of farm products seemed in many cases to excuse if it did not justify.

But the average market values have greatly depreciated, the five crops already mentioned having fallen, during the second period, in their average market value to 75.6 per cent of what it was in the first period, and during the last period having dropped to an average of 67.6 per cent of what these crops sold for during the first period.

The average daily wages of farm laborers in thirty-six States for 10 years have been as follows: Year 1879, wages 94 cents; year 1882, wages $1.07; year 1885, wages $1.05; year 1888, wages $1.06. * * * While, therefore, the actual cost of manual labor remains practically the same, the results of such labor, aided by all these mechanical appliances, have been greatly increased, at the same time introducing a new item into the cost of production, viz, interest and wear and tear of all these implements of husbandry. * * *

The practical conclusions are obvious:

(1) Increase the area and production of grass and hay, and feed it.

(2) Increase and improve the several products of the dairy by careful selection and feeding of the animals, and by improvement in the methods of production of butter and cheese.

REPORT OF FIRST ASSISTANT, W. P. WHEELER (pp. 52–70).

Soils of the farm.—The results are given of mechanical and chemical analyses of samples of soil (top soil and subsoil) taken from different parts of the station farm.

Although the soil contains a large per cent of potash, only a very small part of it exists in a soluble form. The soil from field E, which was the finest of any, and contained 0.95 per cent of potash, had only 0.03 (0.028) per cent soluble in boiling water. The action of frost alone does not perceptibly increase the soluble portion; for some (300 grams) of this same soil, moistened with distilled water and frozen forty-seven times, still contained only 0.03 per cent soluble potash.

Poultry-feeding experiments.—The experiments reported are in continuation of those made in 1888. "In order to observe the effect of rations more or less nitrogenous, during the laying season" two pens of pullets, four Light Brahmas, two White Plymouth Rocks, three Barred Plymouth Rocks, one Buff Cochin, four White-Crested Black Polish, and two Single-Combed White Leghorns, sixteen pullets in each pen, were fed from January to November as follows: Corn on the cob, oats, meat scraps, and a little grass, alike to both pens, but while one pen (No. 6) was given in addition a mixture consisting of three parts of wheat bran, four of linseed meal, and six of ground oats, containing 25.5 per cent of protein, the other (No. 7) was given corn meal containing 12.6 per cent of protein. The nutritive ratio of the food of pen 6 averaged about 1:4.2, and that of pen 7 about 1:5.7. "An accurate account was kept of the weight of the different constituents in the food consumed, the gain or loss in weight, the product of eggs, etc. The results, calculated to the average for one fowl, for the different periods of the experiment, are given in tabulated form."

The average composition is also given of the eggs from each pen, of white-shelled and brown shelled eggs, and of the manure from each pen.

The larger breeds did somewhat better with the more nitrogenous ration, and the smaller breeds considerably better with the less nitrogenous. The average weight per egg was the same for each pen, 2.03 ounces. The brown-shell eggs averaged 2.12 ounces in each pen, and the white-shell eggs 1.85 ounces in pen 6, and 1.93 ounces for pen 7. * * *

The value of the average product of manure per fowl from pen 6 was about 14 cents a year, and from pen 7 about 10 cents, the fresh manure from pen 6 being worth $8.35 and from pen 7 $6.73 per ton.

In another experiment twelve cockerels and twelve capons were fed for fattening.

The fowls were light Brahmas, Plymouth Rocks, and Buff Cochins, and they were fed a mixture of linseed meal, bran, and ground oats; also corn meal, oats, corn on the cob, and meat scraps. * * *

The full value of the experiment as a comparison between the pens was destroyed by the fact that through delay in obtaining instruments the operation of caponizing was postponed too long for the best results, and, also, several "slips" were included in the pen of capons, which was not known until the fowls were killed. The results are of value, however, in connection with those from the pens of laying fowls. Both pens gained in weight during the first two months, and during the third month the capons gained but little, while the cockerels lost in weight. Both continually lost weight after the third month, although the amount of food consumed was not less.

The amount of water-free food consumed per ounce of gain in live weight during the first 2 months was with the capons, 10.4 ounces, and with the cockerels, 12.3 ounces. "The average weight of water free food required by the twenty-four cockerels and capons for 1 ounce of gain was 11.35 ounces, and for the thirty-two pullets during the same period (in the previous experiment), 9.36 ounces.

"The manure collected from the roost platform of pen 5 was at the average rate of 42.8 pounds a year per fowl, and contained 63.9 per cent of moisture; and from pen 8 was at the rate of 43.6 pounds a year, containing 65 per cent of moisture." The manure from the fattening fowls was more valuable than that from those which were laying, due mostly to the larger content of nitrogen.

Poultry house, bull stalls, and piggery.—A description of a poultry house built during the year, and of alterations made in the station barn to provide bull stalls and a piggery.

Sorghum.—Tabulated notes on 82 varieties of sorghum and 2 of millet, including determinations of the sugar content of several varieties of the sorghum.

REPORT OF CHEMIST, E. F. LADD (pp. 71–214).

Analyses of foods.—Analyses are given of alfalfa, mixed meadow-grasses, oat and pea forage, fodder, corn (kernels, tops, butts, leaves, and silage), beets, turnips, hay, corn meal, crushed oats, wheat bran, wheat middlings, rye bran, buckwheat hulls, cotton-seed meal, ground feed, "gluten," palm-nut meal, palm-nut cake, gluten meal, pea-nuts, pea-nut meal, pea-nut vine, pea-nut hulls, and meat scrap; and determinations of albuminoid and amide nitrogen, and of the sugar and starch in a large number of the above materials.

In maize, with Burrill and Whitman corn cut when in milk and King Philip corn at maturity, all cut for forage, we find the invert sugar ranging from 4.60 to 13.16 per cent, sucrose from 2.40 to 10.32, and starch from 11.40 to 43.13 per cent. Can the nitrogen-free extract of these foods have like nutritive value? Differences, such as I have just indicated, though less marked, are found in hay, grains, and waste products.

The percentage of starch and sugar in the nitrogen free extract of numerous feeding stuffs, and the average co-efficient of digestibility for the nitrogen free extract of materials are tabulated. "With two exceptions, red clover and linseed meal, we find that the per cent of nitrogen-free extract, as sugars and starch, agrees very closely with the per cent digested."

Study of the maize plant.—A brief résumé is given of studies made at the station in previous years to determine the best variety of corn for the silo, the best method of planting (in hills or in drills), and the best stage of maturity for cutting corn for silage, followed by a report of the work done in 1889. The author states that from the summary of trials of previous years "it appears that the varieties of flint corn give, under the method of thick seeding, the greatest amount of green forage per acre, and 4 years' trial should give a fair test, including, as they do, several well-known varieties."

"There seems to be no question but what the greatest amount of green forage and dry matter has been produced at this station by thick seeding. Whether by thin seeding, as in the case of hill and drill trials, a greater yield would have been secured may be questioned."

In 1889 the experiments were made with reference to the best stage for cutting for the silo.

"In the latter part of July, in a field of some 12 acres of King Philip corn, 1 acre was selected that to all appearances was as nearly uniform in growth as possible to select, and measured off. The plat included forty rows and these were divided into five sets, one fifth acre each. This gave eight rows to each one fifth acre, and, in order that any inequality in the land or growth of the corn might be counterbalanced so far as possible, it was decided at each cutting of the corn to take rows from each plat."

Five cuttings were made between July 30 and September 23, representing the following stages: "fully tasseled," "fully silked," "kernels watery to full milk," "kernels glazing," and "ripe." Analyses are given of samples taken at each cutting which show the percentage of water, total yield of dry matter, composition of dry matter, and the amount of each constituent, including albuminoid and amide nitrogen, starch and sugar, in crops at different stages.

The conclusions reached last year with Burrill and Whitman corn are in the main borne out by the present season's investigation, and the results of two years' work given in a short summary are as follows:

(1) The greatest weight of green fodder is between the period of full silking and milky stage of kernel.

(2) The total weight diminished after this date but the total dry matter increased.

(3) As the corn approaches maturity the per cent of amide nitrogen diminishes, while the albuminoid nitrogen increases, thus seemingly increasing the feeding value of the crop.

(4) The sugars and starch increase rapidly during the latter period of growth and maturing of the corn plant, and these are the most valuable portion of the nitrogen-free extract.

(5) Between the period of glazing and full ripening of corn there was a large increase in amount of sugar and starch.

(6) For the greatest amount of nutriment, considered from a chemical standpoint, corn should not be cut before it has well ripened.

(7) The Burrill and Whitman corn can not, in ordinary culture, be matured in this latitude.

Cattle foods and feeding rations.—A reprint of Bulletin No. 17 (new series) of the station (see Experiment Station Record, Vol. I, p. 266).

Feeding experiments.—An experiment was made with four 2-year old grade Holstein-Shorthorns "for the purpose of comparing the relative feeding values of a nitrogenous *vs.* a carbonaceous ration with growing and fattening animals." The animals were divided into two lots, each containing two steers and two heifers. The coarse fodders (hay, silage, roots) were the same for both lots, and all received wheat bran and corn meal, but in the case of lot 1 a part of the corn meal fed lot 2 was replaced by either linseed meal, gluten meal, or cotton-seed meal. The entire feeding trial lasted from November 11 to April 23, 163 days; but from February 19 to March 9 a change was made in order to determine the digestibility of the food used, which manifested itself in the following period (March 10–April 23). The tabulated data include the amount of food consumed per lot during the whole experiment.

The gain made during the entire experiment was 13 pounds in favor of the two animals in lot 2 (carbonaceous food), which consumed 396 pounds more of digestible nitrogen-free extract and 197 pounds less of digestible albuminoids than lot 1. In the 109 days from November 11 to February 19 lot 2 gained 20 pounds more in weight, and consumed 209 pounds more of digestible nitrogen-free extract and 110 pounds less of digestible albuminoids than lot 1. From February 19 to April 23, during which time the digestion experiment was carried on and the conditions slightly modified, lot 1 (nitrogeneous ration) gained 7 pounds more than lot 2.

We must then conclude that, so far as this experiment goes, the substitution of nitrogenous foods, like cotton-seed meal, etc., for corn meal and a small quantity of bran, was not followed by any advantage as a fattening ration so far as the increase in live weight indicates.

In general appearance lot 1 looked much the better, having a cleaner, brighter coat of hair. * * * The photographs of the meat show little, if any, difference in the proportion of fat and lean.

The meat for the animals fed the more carbonaceous ration was thought to be "much the tenderer and sweeter."

Digestion experiments.—Six trials were made in connection with feeding experiments, the object being to determine the digestibility of the following single materials and rations: (1) alfalfa hay; (2) mixed hay; (3) hay and turnips; (4) the nitrogenous ration fed in the feeding experiment described above, *i. e.* hay, wheat bran, cotton-seed meal, and corn meal; (5) the carbonaceous ration fed in the same experiment, hay, corn meal, and wheat bran; and (6) a ration made up of hay, oats,

cotton-seed meal, linseed meal, wheat bran, and corn meal. The amount of each constituent fed and digested in each ration and the co-efficients of digestibility found are tabulated.

Amount of dung voided daily.—A tabular statement is given of the amounts of fresh and water-free dung and of urine voided by each of 10 animals daily, and analyses of the dungs and valuation per ton for fertilizing purposes.

Dairy experiment.—A reprint of Bulletin No. 18 (new series) of the station (See Experiment Station Record, Vol. I, p. 269) recording the experiment with different breeds from April to October, 1889.

Relative feeding value of certain grain rations.—One Jersey cow was fed from December 11 to February 22 a ration of hay, silage, and 2 pounds of wheat bran per day, to which was added in period 1 (12 days) 6 pounds of corn meal, in period 2 (21 days) 6 pounds of gluten meal, in period 3 (20 days) 5.5 pounds of linseed meal, and an extra 1.1 pounds of wheat bran. The averages of food consumed and milk produced per day during the last 10 days of each period and the average composition of the milk for the last 4 days of each period are tabulated.

The milk yield gradually fell off during the corn-meal period, but the substitution of an equal weight of gluten meal for corn-meal caused an increased flow of milk, which was well maintained through the period. The substitution of crushed oats for gluten meal failed to maintain the quality of milk during the third period, and in the fourth period the linseed meal, poorly eaten, maintained nearly the same yield as the oats for the whole period, but for the last 4 days the falling off was greater, since very little meal was taken when it was attempted to adjust the ration to correspond with the other periods. * * * It is interesting to note that while the milk yield under gluten meal for 3 days averaged 26.7 ounces more per day than for the previous period with corn meal, yet there was a loss of 1.48 ounces of fat per day. This confirms what has been indicated before, that gluten meal increases the flow of milk without proportionately increasing the solids or the fat, which, in butter-making is the object sought. With crushed oats the milk fell off per day 55.3 ounces, while the fat fell but .72 ounce, and the quality of the butter was much better than that made under gluten-meal food. Linseed meal failed to give as good results as in previous trials, although there was slight increase in fat and a falling off in yield of milk. A part of this effect may be attributed undoubtedly to the small amount eaten. * * * From the trials made with this animal it is evident that gluten meal was a superior food for milk production.

In another experiment similar to the above, also with one Jersey cow, the effects of adding corn meal, linseed meal, palm-nut meal, and "starch waste" from starch and glucose manufacture to the ration, in separate periods, were tested. No analyses of the milk were made. The average amount of food eaten per day and data relative to the churning of the cream are tabulated.

Taking only the last 10 days of each period, we have indications that with the cow under experiment 3.8 pounds of linseed meal and 3.5 pounds of wheat bran are just about equivalent to 8 pounds of corn meal for maintaining the milk yield, but we find that 5.1 pounds less milk was required for 1 pound of butter [with the former feed]. In period 3, under palm-nut meal, there was a falling off in milk of 2.6 pounds per day. Under dry feed (starch waste) this decrease in milk was arrested, and the

yield steadily increased to the close, indicating, as has been previously shown at this station, the value of this dried by-product from the starch and glucose manufactories for milk production.

The treatment of the milk and cream was always the same, but this trial can only be taken as indicating what has been found in other trials heretofore, that linseed meal gives more butter than corn meal.

Dairy notes.—(1) *Sweet vs. ripened cream.*—The cream raised each day was divided, one half being churned sweet and the other allowed to ripen before churning. The sweet cream was churned at different temperatures between 50° and 68° Fah. The tabulated results indicate that—

By churning sweet cream at the same or a higher temperature than is required for ripened cream there was a large loss of butter fat, in one case amounting to a little more than one fifth of the total butter present in the cream, but by lowering the temperature to from 50° to 54° Fah. there was no greater loss than with the same cream ripened.

The quality of the butter, both in grain and color, steadily improved as the temperature for churning was lowered, and at 50° and 54° Fah. was as good in appearance as that from well-ripened cream. The flavor of the butter from sweet cream is quite different from that of butter made from ripened cream. In every case there was found less casein in the butter from sweet cream than in that from ripened cream.

(2) *Ash constituents of milk and cream.*—An estimation of the amounts of the several fertilizing ingredients contained in the milk, cream, and skim-milk of an average cow per year.

"By feeding the skim-milk upon the farm, and selling the cream, we only remove about one tenth as much as would be found in the whole milk. If the skim-milk and buttermilk are all consumed upon the farm and only the butter sold, then the amount of fertility sold from the farm in the way of nitrogen, phosphoric acid, potash, and lime is almost nothing."

(3) *Pounds of milk or of cream for one pound of butter.*—A statement of the average number of pounds of milk or cream from the station herd required to make 1 pound of butter, during each month of the year.

(4) *Influence of temperature on creaming milk submerged in water.*—In comparative tests made with milk submerged in spring water at 56° Fah., and in ice water, "fully three fourths of a pound more of butter per 100 pounds of milk was secured by the use of ice in the water."

(5) *Influence of food on butter.*—A general summary of the results of feeding experiments with milch cows during the past 2 years. Three Jersey and two native cows were used in these experiments.

When hay alone was fed the yield of milk, and butter as well, was always the lowest. The addition of 8 pounds of corn meal per day increased both the flow of milk and the yield of butter over that of hay alone, but the butter fat in the milk, as shown by analysis, did not increase in proportion to the yield of milk. The substitution of 5 pounds per day of linseed meal for 6 pounds of the corn meal, making the grain ration 2 pounds of corn meal and 5 pounds of linseed meal, gave a smaller yield of milk than when corn meal alone was fed. The yield of butter fat nevertheless was increased in every trial with linseed meal, and in the case of two cows with the same relative increase would amount to more than 70 pounds of butter per year for each

cow. Replacing the 5 pounds of linseed meal with 8 pounds of wheat bran the milk yield was rather less on the whole, but in one case more than when linseed meal was fed. The yield of butter was considerably diminished.

The substitution of oats for the linseed meal was followed by a smaller milk yield and less butter, but of superior quality to that from linseed-meal food.

The experiments with silage and cotton-seed meal have not been repeated a sufficient number of times to warrant any definite conclusions. With silage the chief difference noted was the more efficient recovery of the fat in the butter, and the butter under cotton-seed meal was of much better quality than when linseed meal was fed. * * *

Of all grain foods tried, gluten meal gave the largest flow of milk, but the per cent of fat was exceptionally low. Dry feed, a waste product from the manufacture of starch and glucose from corn, ranked next to gluten meal. Corn meal followed these for producing flow of milk. Linseed meal gave the largest amount of butter, but the quality was not of the best, being too soft. Oats gave the best-colored and hardest butter, but somewhat crumbly. A combination of foods was the most satisfactory butter ration.

In the feeding trials made with five individual animals we find that the character of the food did largely influence both the yield of butter and the quality.

REPORT OF FARM SUPERINTENDENT, F. E. EMERY (pp. 215–297).—The following topics are treated: grass plats and forage crops; potato experiments; fertilizer experiments with corn; corn in hills, drills, and broadcast; variety tests of corn, beets, and carrots; fertilizer experiments with grass; relative yields of four varieties of barley; warm water for milch cows; subsoiling experiments; the manure platform.

Grass plats and forage crops (pp. 216–223).—Notes in continuation of those in the Annual Report of the station for 1888 (See Experiment Station Bulletin No. 2, p. 164). The number of different grasses, clovers, and other forage plants grown at the station on small plats was increased in 1889 so as to include some 65 species and varieties. In addition to the species especially recommended in the Report for 1888, meadow foxtail (*Alopecurus pratensis*), orchard grass (*Dactylis glomerata*), tall meadow oat grass (*Avena elatior*), yellow oat grass (*Avena flavescens*), and sheep's fescue (*Festuca ovina*) for pasturage, and the rye grasses (*Lolium paceyii* and *L. perenne*) have given good results.

Tabulated data are given for the yields in 1889 of mixtures of forage plants seeded on large plats in 1886. The best yields were on the plats where (1) alsike clover, perennial rye grass and timothy; and (2) meadow fescue, timothy, Kentucky blue-grass, and white, alsike, and red clovers were the leading plants. The yields of alfalfa and prickly comfrey in 1889 are given in a separate table. In 1889, as in the previous year, prickly comfrey did not make good silage or hay. Alfalfa, however, was the main-stay as a soiling crop, "having been the first thing ready to feed in the spring, and the fourth crop the last in the fall." [For the results of 7 years' experience with alfalfa at this station, see Bulletin No. 16 of the station, or Experiment Station Record, Vol. I, p. 266.]

The kinds and amounts of seed used in a new series of mixtures of grasses sown in the spring of 1889 are stated in a table.

Potato experiments (pp. 223-256).—These included experiments with different amounts and kinds of seed, methods of planting, and fertilizers.

(1) *Whole tubers vs. cuttings for seed.*—Whole and half tubers and three, two, and one-eye cuttings of the White Star variety were planted on one series of plats May 4, and on another series May 16 to 20. The results given in detail in tables show a steady decrease of yield from the whole tubers to the one-eye cuttings. A summary of similar experiments at other stations is quoted from Bulletin No. 2 of the Maryland Station.

(2) *Similar weights of seed per row in hills and drills.*—The same weights of seed of different sizes, from whole tubers to one-eye cuttings, were sown in hills and in drills. The results, as tabulated, uniformly favored planting in drills.

(3) *Equal weights of seed in the hill.*—A small area was planted June 18 with whole and half tubers and three, two, and one-eye cuttings, 2 ounces of seed being used in each hill. The results, as tabulated, favored the half tubers.

(4) *Large vs. small tubers for seed, and the same with the seed ends removed.*—The results of a small experiment, as tabulated, favored the large tubers and the uncut seed.

(5) *Selected tubers for seed.*—One hundred tubers of equal weight, best tubers from the best hills and the poorest hills, tubers of various sizes from the general stock, and irregular tubers, were planted separately. The report states that the experiment was unsuccessful, but tabulated data are given as a matter of record.

(6) *Relative yields from eyes removed and not removed from the seed tuber.*—Notes and tabulated data are given for small experiments, in which the following questions were considered: "Which eye of a potato will vegetate first? And which, if any one, is most prolific? Also, how does each individual eye, when removed by cutting to the center, compare in vigor, as shown by early germination and in prolificacy, with an eye correspondingly distant numerically from the stem, but not removed from the tuber, all other eyes on the tuber being destroyed?"

(7) *Seed planted on the surface or in the furrow.*—The results of an experiment with different amounts of seed on 2 tenth-acre plats, as tabulated, slightly favored planting in the furrow.

(8) *Experiments with different kinds of fertilizers.*—Dissolved boneblack, sulphate of ammonia, chloride and sulphate of potash, and nitrate of soda, in different combinations, were applied in 1889 on fifteen plats. Notes on the previous manuring of the plats are given, and the results of the experiment are tabulated and discussed. Where no potash was used the yield was materially decreased, and there was a relatively small decrease where no nitrogen was used. The application of potash had no effect in preventing the ravages of the potato rot.

(9) *Fertilizers below vs. above the seed.*—Tabulated data are given for an experiment in 1889 on 2 tenth-acre plats. The results agree with those of a similar experiment in 1888 in showing no marked difference in favor of either method of application.

(10) *Muck vs. manure.*—The results of equal applications of muck and stable manure on two plats favored the former.

Fertilizer experiment with corn (pp. 256–260).—This is a continuation of an experiment begun in 1888 (See Annual Report of the station for 1888, p. 356, or Experiment Station Bulletin No. 2, p. 165). The fertilizers used in 1889 were nitrate of soda, sulphate of ammonia, sulphate of potash, dissolved bone-black, plaster, guano, chloride of potash, dissolved and ground South Carolina rock, nitrate of potash, "High Grade Farmers' Friend," barn-yard manure, and muck. Several plats received no manure. Rye was sown the previous fall and in the spring and plowed in. The variety of corn planted was Waushakum. Details are given in two tables.

Field notes this year, as last, testify to the stockiness and general thrift of plants where nitrogen as nitrate or sulphate has been applied. The amounts applied in most cases produced an increase in the ratio of stalks to corn, but had an equal if not greater effect on the yield of sound corn.

Neither potash nor phosphoric acid has exerted a marked influence on the crop.

The application of plaster has not been followed by any increase of crop above the general average.

The plat to which muck was applied has this year fallen far below the general average.

Nitrogen alone, with either potash or phosphoric acid, or with both potash and phosphoric acid has increased the crop.

Corn has been selected from each plat for seed on the plat where it grew, in order that the full cumulative effect of the fertilizer may be felt.

Corn in hills and drills and broadcast (pp. 260–263).—On 18 twentieth-acre plats King Philip corn was planted in hills and drills and broadcast, in different degrees of thickness. The results, as tabulated, show that—

The hills yield most, the drills next, and the broadcast least in case of almost every plat, notably so in the summary. Not only is this the case, but we find the individual weight of stalks most in hills, medium in drills, and least when grown broadcast. The stand of corn as harvested, owing to the unfavorable circumstances of the season, bears no commensurate relation to the amount of seed sown.

Sorghum in hills and drills (pp. 263–266.)—"May 18, 1889, 9 twentieth-acre plats were planted with Early Amber sorghum seed, every alternate row being in drills and the others in hills 3 feet apart in the row. The rows were 3½ feet apart." The results, as tabulated, strongly favored planting in drills. "The yield in every case increased with the number of plants for a given area, but not in direct proportion, as it will be noticed the average weight of individual plants decreased to a considerable extent."

Test of varieties of fodder corn (pp. 266–273).—Tabulated data are given for 6 varieties of flint, 1 of dent, and 3 of sweet-corn.

With this season, and the length of time allowed in September before harvesting, giving 145 days between planting and harvest, the large late-growing varieties have proved to yield greater crops, and also larger amounts of dry matter per acre than the smaller varieties. * * * To shorten the season much would put a different aspect on the ratio of yields from all our varieties, and it is doubtful if the large varieties could still lead under the different order of things.

It is probable that the dry matter of these varieties which have been cut at different periods of growth, has a different relative composition, and hence a somewhat different feeding value. But it is hardly to be expected that these changes in the above crop could equal the differences in yield in favor of the large varieties.

Tests of varieties of beets and carrots for cattle food (pp. 273–275).—Tabulated data for 15 varieties of beets and 5 of carrots.

Fertilizer experiments with grass (pp. 275–288).—An experiment made in 1888 was reported in Bulletin No. 13 (new series) and the Annual Report of the station for 1888, pp. 340–343 (See Experiment Station Bulletin No. 2, p. 165). The experiments in this line in 1889 were (1) on one of the series of plats used in 1888, which received no further applications of fertilizers; (2) on a new series of plats fertilized in the same way as those used in 1888, except that the sulphate of potash was of double strength but in half the amount used the previous year; (3) on a third series of plats where nitrogenous fertilizers were chiefly used. Timothy, alsike and red clover, yellow trefoil, and wire-grass (*Poa compressa*) were the varieties grown on all the plats in 1889. Details are given in notes and tables. The following summary is taken from the report:

(1) On this farm, with our heavy clay soil, nitrogen in an easily soluble form is the predominant element for the grass family.

(2) Together with other elements, phosphoric acid and potash do not seem to be needed by this soil, though applications of these two elements, separately and combined, add a considerable percentage to the crop, yet not enough to bring a profit for the application.

(3) Of the easily soluble but costly nitrogen salts, light applications are more profitable than greater, and the cheaper and more soluble sodium nitrate than the other forms tried.

(4) It is probable that two or three applications, preceding light rain, would prove more profitable than a single application, especially if it should be followed by heavy rain.

(5) This single season's trials of cotton-seed meal and wheat bran indicate that they can be profitably used as sources of nitrogen for top dressing grass lands.

(6) The effect of spring applications of easily soluble nitrogenous fertilizers seems to be about exhausted during the season.

(7) The second season's influence of phosphoric acid and potash seems to have been to increase the clover or leguminous plants relatively to timothy or graminaceous plants.

Test of varieties of barley (pp. 288, 289).—Notes and tabulated data for 4 varieties.

Warm water for milch cows (pp. 290–294).—Notes and tabulated data are given for an experiment in which one cow was given water at 96° Fah. for 10 days (March 5–14), and at 36° Fah. for 10 days (March 15–24). A contrivance used in heating the water is described and illustrated.

For the warm-water period the total milk yield was 380.9 pounds, averaging 39.2 pounds for the last 5 days. For the cold-water period the total milk yield was 375.5 pounds, averaging 37.6 pounds for the last 5 days. The total gain in yield of milk during the warm-water period was 5.4 pounds, and for the last 5 days the gain averaged 1.6 pounds.

Subsoiling experiments (pp. 294–296).—A brief account of experiments in which there was a slight gain in yield for subsoiling oats but a loss from subsoiling corn in the season of 1889.

The manure platform (pp. 296, 297, illustrated).—A brief description of the platform constructed at the station in 1889 on which the solid excrement and soiled bedding from the barns can be piled. "Under the platform are three cisterns to hold urine from the stables and overflow from the platform in rainy weather."

REPORT OF ACTING HORTICULTURIST, C. E. HUNN (pp. 298-336).

Strawberries (pp. 298–308).—Tabulated data and descriptive notes on 52 varieties. There are also brief notes on experiments in the selection of plants for cross-fertilization.

Raspberries (pp. 308–311).—Tabulated data and descriptive notes on 29 varieties.

Currants, blackberries, and gooseberries (pp. 311–313).—A list of 23 varieties of currants, and 22 of blackberries planted at the station, and brief descriptive notes on 14 varieties of gooseberries.

Beans (pp. 313–317).—Tabulated data and descriptive notes on 27 varieties of bush and 9 of pole beans.

Peas (pp. 318, 319).—Descriptive notes on 3 varieties and tabulated data for 10 varieties.

Corn (p. 320).—Descriptive notes on 6 varieties and tabulated data for 10 varieties.

Potatoes (pp. 321–325).—Tabulated data for 47 varieties.

Sweet-potatoes (pp. 325, 326).—Tabulated data and descriptive notes on 4 varieties successfully grown at the station.

Carrots (pp. 326, 327).—Tabulated data and descriptive notes on 2 varieties.

Tomatoes (pp. 327–329).—Descriptive notes on 5 of the new varieties, tabulated data for 18 varieties, and notes on tests of tomato seed.

An experiment started in 1883 to note the influence of seed from ripe and green fruits of the tomato, has been carried on to date. The results each year have been the same, the seed from green fruits producing plants of impaired vigor, but earlier to ripen fruits, which are small but abundant. * * *

In a test made this year of large and small fruits from the same tomato plant, to ascertain the difference in productiveness, size, and earliness, it was found that the seed from small fruits produced plants of but medium vigor and productiveness, but very early, and as large fruits as the plants from large fruits. The latter were more vigorous and productive, and 10 days later to ripen fruits.

Onions, cabbages, cauliflowers, and lettuce (pp. 330–333).—Tabulated data for 12 varieties of onions, 8 of cabbages, 4 of cauliflowers, and 5 of lettuce.

Insects, insecticides, and fungicides (pp. 333–335).—Brief notes on experiments in the treatment of the cucumber and potato beetles, currant worm, and mildew of the gooseberry.

A disease of the hollyhock (p. 335).—Brief note on *Puccinia malvacearum*, found in 1889 on the grounds of a nurseryman in the vicinity of the station.

Test of plant protector (p. 336).—Brief note on a patent plant protector.

REPORT OF ACTING POMOLOGIST, G. W. CHURCHILL (pp. 337–373).—This is for the months April–October, inclusive, and embraces the following subjects: (1) care and improvement of the orchard; (2) notes on fruits; (3) lists of varieties; (4) spraying with insecticides and fungicides; (5) seed selection, with notes on vegetation.

The work has been for the most part a continuation of that outlined in Bulletin No. 15 (new series) of the station and referred to in the Annual Report for 1888 (See Experiment Station Bulletin No. 2, p. 145).

Care and improvement of the orchard (pp. 337–339).—Brief notes on the pruning and manuring of the station orchard.

Notes on fruits (pp. 339–346).—Brief notes on apples, pears, peaches, and apricots, together with tabulated data for 50 varieties of grapes planted 1882–87, and for 72 varieties planted in 1888.

Lists of varieties of fruits (pp. 347–357).—These lists contain 217 (including 50 Russian) varieties of apples, 11 of crab apples, 85 (15 Russian) of pears, 78 (9 Russian) of plums, 31 of cherries, 56 of peaches, 21 of apricots, 5 of quinces, 12 of nectarines, and 117 of grapes, placed under trial previous to 1889; and 65 of apples, 8 of crab-apples, 18 of pears, 25 of plums, 8 of cherries, 12 of peaches, 2 of apricots, 1 of quinces, 16 of grapes, and 19 of wild grapes, added to the experimental orchard in 1889.

Spraying with insecticides and fungicides (pp. 358–364).—Notes on experiments in spraying apple and plum trees with Paris green and London purple for the codling moth and curculio, grape-vines with sulphide of potassium for the downy mildew, and apple and cherry-trees with kerosene for plant-lice.

Seed selection, experiment with beans (pp. 364–373).—Notes and tabulated data on plat experiments in 1887 and 1888 in which the results of planting large and small seed of Golden Wax beans were compared. The yields in both years favored the large seed. The plants which vegetated from each kind of seed were counted each season daily from June 3 to July 2, inclusive. Similar observations were made on Boston Dwarf Early and Aroostook beans planted in the greenhouse. It was found that at first the small seed vegetated more rapidly, but after a few days the plants from the large seed outnumbered those from the small seed, and that the plants from the large seed were more vigorous.

REPORT OF ACTING METEOROLOGIST, F. E. EMERY (pp. 374–404).

Notes on fluctuations in the height of water in an unused well (pp. 374–377).—A continuation of observations reported in the Annual Report of the station for 1888, p. 197 (See Experiment Station Bulletin

No. 2, p. 152). The height of water in a well near the station has been observed at different times since December, 1886, and compared with the rain-fall. The results are stated in a table and diagram. It has been found that fluctuations in the precipitation from month to month did not much affect the height of the water-table, and that the rapid rise of the water in the well at different times could not always be explained as due to large precipitations occurring at or near the period of the rising.

Meteorology in 1889 (pp. 377–401).—Notes on the weather and tabulated details of observations of temperature of the air, rain-fall, direction and velocity of the wind, amount of sunshine, and soil temperatures at the surface and at depths of from 1 to 18 inches.

North Carolina Station, Bulletin No. 73, October 15, 1890 (pp. 100).

THE BEST AGRICULTURAL GRASSES, G. MCCARTHY, B. S. (illustrated).—This is a useful compendium of information regarding a number of species of grasses, clovers, and other forage plants, prepared from the standpoint of the intelligent farmer in the Southern States, The bulletin is divided into the following chapters: (1) introductory, (2) leading grasses and clovers, (3) forage plants of minor importance, (4) tabulated data, (5) the quality of commercial grass and clover seed, (6) mixtures *vs.* pure sowings of grasses, (7) the rational mixing of grass and clover seeds, (8) the use and value of grass gardens and experimental plats, (9) manures for grasses, (10) diseases and insect enemies of grasses and clovers, (11) the formation and care of grass lands, (12) formulas for mixtures, (13) index.

Introductory (pp. 4, 5).—The importance of giving more attention to the culture of forage plants is urged, and it is stated that "the selections and recommendations made in this work are based partly upon the results of experiments begun on the North Carolina Experiment Farm in 1866; partly upon the reports of similar tests made at different American and many foreign experiment stations, and partly upon the personal observations of the writer in several of the Southern States. Many facts and chemical analyses have been drawn from standard works."

The leading grasses and clovers (pp. 6–46).—Illustrated notes on the habits of growth of 28 species, together with their chemical composition, yield, amount and value of product, etc., and with especial reference to the results of experience with these plants in the Southern States. The illustrations are taken from the bulletins of the United States Department of Agriculture and from foreign sources. The following species are described: Bermuda grass (*Cynodon dactylon*), crested dog's-tail (*Cynosurus cristatus*), English blue-grass (*Poa compressa*), tall fescue (*Festuca elatior*), sheep's fescue (*Festuca ovina*), hard fescue (*Festuca duriuscula*), red or creeping fescue (*Festuca rubra*), florin

or creeping bent grass (*Agoostes stolonifira*), fowl meadow-grass (*Poa serotina*), Johnson grass (*Sorghum halepense*), Kentucky blue-grass (*Poa pratensis*), meadow fox-tail grass (*Alopecurus pratensis*), tall oat grass (*Arrhenatherum avenaceum*), orchard grass (*Dactylis glomerata*), redtop or herd's grass (*Agrostis vulgaris*), rough stalked meadow-grass (*Poa trivialis*), perennial rye grass (*Lolium perenne*), Italian rye grass (*Lolium italicum*), sweet vernal grass (*Anthoxanthum odoratum*). timothy (*Phleum pratense*), alsike clover (*Trifolium hybridum*), crimson clover (*Trifolium incarnatum*), Japan clover (*Lespedeza striata*), alfalfa (*Medicago sativa*), red clover (*Trifolium pratense*), white clover (*Trifolium repens*), cow-pea (*Dolichos sinensis ?*), soja bean (*Glycine hispida*).

Forage plants of minor importance (pp. 47–63).—Illustrated notes, similar to those in the preceding chapter, for 16 species, including American canary grass (*Phalaris intermedia*, var. *angustata*), rescue or Schrader's brome grass (*Bromus unioloides*), Hungarian or awnless brome grass (*Bromus inermis*), crab grass (*Panicum sanguinale*), gama grass (*Tripsacum dactyloides*), Kaffir corn (*Sorghum vulgare*, var.), pearl millet (*Pennisetum spicatum*). Italian millet (*Setaria italica*), Texas blue-grass (*Poa arachnifera*), Texas millet (*Panicum texanum*), Louisiana or carpet grass (*Paspalum platycaule*), prickly comfrey (*Symphytum asperrimum*), Bokhara clover (*Melilotus alba*), burr clover (*Medicago maculata*), vetch (*Vicia sativa*), and yarrow (*Achillea millefolium*).

Tabulated data (pp. 64–70).—Under this head are included six tables containing data for some 25 of the species described in the foregoing chapters, regarding the period of flowering, proper soil for growth, average yield per acre, use for meadow or pasture, seeds (amount required, etc.), proximate composition and feeding value of the hay, digestion co-efficients (for 8 species), amount of each ash constituent in 2,000 pounds of the air dry hay, and the theoretical feeding and manurial value of the hay.

Quality of commercial grass and clover seed (pp. 71–78).—The form of germinating pan used at the station is described and illustrated. Brief accounts are given of the adulterations commonly found in different species of grasses, and the seeds of some of these grasses and of the weeds likely to be mixed with them are illustrated.

Mixtures vs. pure sowings of grasses (pp. 79–81).—A brief argument in favor of the use of mixtures of grasses whenever practicable in order to make the best use of the resources of the air and soil.

In forming mixtures for mowing land the farmer must not only select species suitable for his soil, but from among these he must choose those which come to the cutting stage or bloom nearly at the same time. He must also, as elsewhere explained, choose tall and low-growing, deep and shallow-rooting species. Among good meadow-grasses the number which meet all these requirements are very few. Therefore good meadow mixtures must include but a small number of species. For pasturage, on the other hand, we want a large number of species which come to the flowering stage at different periods.

The rational mixing of grass and clover seeds (pp. 82, 83).—Formulas are given for calculating the amounts of different kinds of seeds to be used in mixtures for sowing on a given area.

The use and value of grass gardens and experimental plats (p. 84).—Farmers are urged to make use of experimental plats in testing varieties of forage plants and the fertilizers for them, adapted to individual soils.

Manures for grasses (pp. 85, 86).—Illustrations are given to enforce the desirability of a careful study of the varying necessities of plants for appropriate nourishment.

Diseases and insect enemies of grasses and clovers (pp. 87, 88).—Brief suggestions for the treatment of grass lands for the repression of diseases and insect enemies of the plants.

The formation and care of grass lands (pp. 89, 90).—Practical hints on the culture of grasses.

Experience has shown that in the Southern States all permanent grasses and clovers do best when sown in the fall, from August 15 to October 1. * * * The use of "nurse crops," either of cereals like oats or of some growing annual grasses like Italian rye grass, is now disapproved by the best authorities. Such nurse crops really act as weeds, smothering out the plants they were meant to assist and disappearing themselves at the end of a year or two, leaving the sward open for other weeds to come in. The soil for grass fields requires careful preparation. * * * A good preparation for a permanent grass field is a crop of cow-peas, heavily fertilized with potash and phosphate, planted in spring and plowed under in August. * * * Most grasses root shallowly and soon exhaust the top layer of the soil, whereas red clover and lucern root deeply, feeding upon the lower layers of the soil, and in addition add to the soil nitrogen taken from the air.

Formulas for mixtures (pp. 91–97).—Twenty-four formulas for mixtures to be used on different kinds of soil for permanent pasture, permanent and temporary meadow, and special purposes.

North Carolina Station, Bulletin No. 74a (Meteorological Bulletin No. 15), December 31, 1890 (pp. 18).

METEOROLOGICAL SUMMARY FOR NORTH CAROLINA, DECEMBER, 1890, H. B. BATTLE, PH. D., AND C. F. VON HERRMANN.—Notes on the weather, and monthly summaries and a tabulated daily record of meteorological observations by the North Carolina weather service. The bulletin is illustrated with maps of North Carolina, showing the isothermal lines and the total precipitation for different parts of the State.

Summary of observations by the North Carolina State weather service co-operating with the United States Signal Service, for the years 1887–90.

	Atmospheric pressure.					Air temperature.									
	Mean reduced barometer.	Extremes.				Monthly mean.	Extremes.						Mean minimum.	Monthly range.	Mean range.
		Highest.*	Date.	Lowest †	Date.		Maximum.	Date.	Mean maximum.	Minimum.	Date.				
Means for—															
1890	30.11	73	Jan. 28	33	Dec 17	60.7	103	June 29, 30	70.7	4	Mar. 16		51.1	46.7	19.5
1889	30 08	81	Feb. 24	19	Apr 26	59 4	100	July 10	63.2	6	Feb. 7		50 5	45 0	17.7
1888	30 09	79	Jan 12	22	Dec. 17	59.0	104	July 9	68.6	6	Jan.		49 3	46.5	19.3
1887	30 07	83	Dec. 1	14	Aug 20	59.1	107	July 18	69.1	‡4	Jan.		50.7	46.2	18.4

* Supply 30 inches. † Supply 29 inches. ‡ Below zero.

	Mean relative humidity.	Monthly precipitation, including snow—inches.	Winds.				Number of rainy days.	Number of cloudy days.	Number of fair days.	Number of clear days.	Average of the total wind movements.
			Prevailing direction.	Maximum velocity.							
				Miles per hour.	Direction.	Date.					
Means for—											*Miles.*
1890	75.1	3 87	S. W.	63	N. E.	Sept. 29	107	105	125	135	5,491
1889	75 7	4.23	S. W	84	E.	Mar. 10	113	121	112	132	5,277
1888	76.2	4.53	S W.	66	N	Nov. 25	118	117	116	133	....
1887	73 3	4.11	S. W.	82	S. E.	Aug. 20	125	100	138	127	....

Ohio Station, Bulletin Vol. III, No. 8 (Second Series), September, 1890 (pp. 18).

An account of the following article was omitted from the abstract of this bulletin in Experiment Station Record, Vol. II, p. 290:

ON THE LIFE HISTORY OF THE CLOVER STEM-BORER, C. M. WEED, M. S. (pp. 235–238, illustrated).—Brief notes are given on observations of the clover stem-borer (*Languria mozardi*) on different kinds of plants, and a list of 16 species of plants on which this insect has been known to feed. Of these the following 10 species have not previously been recorded as food plants for this borer: *Melilotus alba*, *Erigeron philadelphicus*, *E. canadensis*, *Cnicus altissimus*, *Lactuca canadensis*, *L. floridana*, *Rudbeckia laciniata*, *Achillea millefolium*, *Campanula americana*, and *Urtica gracilis*. The three later stages of the clover stem-borer are briefly described and illustrated, as well as a parasite observed on a single pupa of the borer.

Ohio Station, Bulletin Vol. III, No. 9 (Second Series), October, 1890 (pp. 11).

ASPARAGUS AND TRANSPLANTING ONIONS, W. J. GREEN (pp. 241-251, illustrated).

Seed-bearing and non-seed-bearing asparagus.—"The male and female flowers in the asparagus are borne on separate plants; hence, as is well known, all of the plants do not produce seeds. Seed-bearing is an exhaustive process, and, as might be supposed, those plants that produce seed have less vigor than those that do not. In order to determine the difference in vigor between the seed-bearing and non-seed-bearing plants, fifty of each were staked off in a plantation of about half an acre. When the cuttings were made the shoots taken from male and female plants were kept separate and the weight of each recorded."

Observations upon the two kinds of plants were extended through the seasons of 1889 and 1890, and cuttings were made in the ordinary manner. The results are as follows:

Asparagus, product from male and female plants.

	Product from 50 male plants	Product from 50 female plants.
	Ounces	*Ounces*
First period, 10 days	37	21
Second period, 10 days	104	68
Third period, 10 days	266	164
Fourth period, 10 days	203	154
Total for the season	610	407

The total average gain of the male plants over the female was a little more than 33 per cent, while in the first period the gain was 43 per cent. The greatest difference between the two lots occurred during the first period, showing that male plants are earlier than the others. The shoots from the male plants were also larger than those from the female. Male plants can be secured by dividing old roots or by selecting such 2-year-old seedlings as do not bear seeds.

The use of rubber bands in bunching asparagus.—Rubber bands are found to be superior to string for bunching asparagus, because they hold the stalks in place better, and they are also cheaper when the labor of putting them on is considered.

"The method employed in bunching with rubber bands is to slip a band over an ordinary tea-cup—one with straight sides and without a handle—fill the cup with asparagus shoots, the heads downward, and then slip the band from the cup to the bunch. This makes a bunch of about the right size, and gives the upper end a nicely rounded appearance. All that remains to be done is to slip on another band and to square the butts with a sharp knife. Possibly a metallic cup would answer better, being thinner, but a tea-cup is not objectionable in this

particular. If smaller bunches are desired than the smallest cup that can be found, it is not necessary to fill the cup."

Two thousand bands suitable for bunching are contained in 1 pound, and they can be purchased for $2. Two bands are used for a bunch.

Transplanting onions.—Experiments in transplanting onions have extended through three seasons (1888–90). The results agree, as the author is careful to state, with those obtained from similar experiments by T. Greiner, an account of which was published in 1889.

The plan followed here has been to sow seed in the greenhouse, in trays or flats, about six weeks in advance of the time that the ground is usually fit to work out of doors. Sowings were made the past season February 25. The seed came up promptly and more uniformly than that sown out of doors, while the plants advanced rapidly in growth, being 6 to 8 inches in height by the middle of April. As soon as the ground was dry enough to work, two beds were prepared in the garden, side by side, the manner of preparation, manuring, etc., being alike for both. In one bed seed was sown of the same varieties that had been started in the greenhouse, in rows 1 foot apart, care being taken to use sufficient to secure a good stand. When the onions in this bed had reached the proper size the plants were thinned so as to stand the same distance apart as those in the other bed. The second bed was filled with the young plants from the greenhouse. The plants were placed 3 inches apart in the rows, the distance between the rows being 1 foot.

The results in both beds are reported in tabular form for 16 varieties. In every case the transplanted onions yielded best, the increase from transplanting in some cases amounting to 100 per cent. These causes are held to account for this increase:

"(1) Longer period of growth of the transplanted onions than those sown in the field. The transplanted onions ripened earlier than the others, and yet had a longer time in which to grow before the hot weather came. (2) The transplanted onions had decidedly the advantage of making the greater share of their growth early in the season, during the cool weather, before the others had fairly started. (3) The transplanted onions were much more uniform in size than those grown from seed sown in the open ground."

This gain in earliness can be utilized to produce green or bunch onions from seed in the place of sets. The late foreign varieties were particularly benefited by this treatment. Red Rocca, Pompeii, Prizetaker, Madrid, and White Victoria gave an average increased yield of 78 per cent, due to transplanting.

The difference in yield between transplanted onions and those grown from seed would evidently be much greater some seasons than others, because the ability to secure a perfect stand from seed sown in the field depends largely upon the weather, vitality of the seed, and character of the soil. These elements of failure do not appear when transplanting is practiced unless the seed is nearly worthless, since but few plants perish in transplanting. Possibly, with all conditions favorable, and upon mucky soils, there would be but little difference in the yield secured by the two methods, especially with Danvers and Wethersfield. On clay soils, similar to that upon which the experiment was tried, it is probable that the difference would be even greater in most seasons than in 1890, since the conditions were then uncommonly favorable for the securing of a good stand.

The extra labor in transplanting is fully offset by the saving in labor of weeding and thinning, and as the yield is greater from the transplanted crop it follows that transplanted onions can be grown cheaper per bushel than those grown in the ordinary way.

Ohio Station, Bulletin Vol. III, No. 10 (Second Series), November, 1890 (pp. 22).

EXPERIMENTS IN PREVENTING DOWNY MILDEW OR BROWN ROT OF GRAPES, C. M. WEED, D. SC. (pp. 253–263, illustrated).—A popular account of the downy mildew fungus (*Peronospora viticola*) and its effects on the grape, with statements regarding experiments by fruit growers in Ohio in 1890 with eau celeste, ammoniacal solution of carbonate of copper, and copperas. Eau celeste uniformly gave good results, carbonate of copper was variable in its action, and copperas proved ineffective. Spraying apparatus is illustrated.

THE SMUT OF INDIAN CORN, C. E. BESSEY, PH. D. (pp. 264–272, illustrated).—A reprint of an article from Bulletin No. 11 of the Nebraska Station (See Experiment Station Record, Vol. I, p. 253).

Oregon Station, Bulletin No. 8, January, 1891 (pp. 17).

NOTES ON VARIETIES OF WHEAT AND FLAX, H. T. FRENCH, M. S.—Descriptive and tabulated notes on 72 varieties of wheat and a brief account of a test of a single sample of flax.

Pennsylvania Station, Bulletin No. 13, October, 1890 (pp. 8).

BLACK KNOT ON PLUMS, G. C. BUTZ, M. S. (pp. 3, 4, illustrated).—The black knot (*Plowrightia morbosa*) of the plum is briefly described and growers are urged to destroy it on both the wild and cultivated plums and cherries. The disease may propagate itself in winter as well as in summer.

"The simplest and most effectual remedy for this disease is to cut away the branches on which the warts appear, which may require the sacrifice of a large portion of the tree should the excrescence be found on heavy limbs. November and December are good months in which to do this work. *Every piece of wood in which the fungus occurs should be collected and burned at once*, as the winter spores are known to have ripened in severed branches. Burning the material is, therefore, an essential part of the remedy. Every trace of the disease should be destroyed, not only from one orchard but from neighboring orchards."

To test the efficiency of slicing off the excrescenses on old branches the author cut off knots which "appeared low down on healthy branches," and only two of them returned.

A FEW ORNAMENTAL PLANTS, G. C. BUTZ, M. S. (pp. 5–8, illustrated).—Our successful ornamental plants represent nearly all countries

of the world. Hardiness is not dependent entirely upon severity of winter, but often upon humidity, cloudiness, etc. Many of the so-called novelties are really old plants whose merits have long since been determined. The following interesting plants found hardy in Pennsylvania are briefly described in this article: *Arundo donax*, *Bocconia cordata*, *Stachys lanata*, *Aster novæ-angliæ*, and *Œnothera missouriensis*. The *Grevilleæ* are recommended for greenhouse use, and especially *Grevillea robusta*, which is described and illustrated.

Pennsylvania Station, Bulletin No. 14, January, 1891 (pp. 15).

TESTS OF VEGETABLES FOR 1890, G. C. BUTZ, M. S.—Tabulated and descriptive notes on 18 varieties of beans, 2 of beets, 1 of cabbages, 4 of cauliflowers, 1 of carrots, 2 of cucumbers, 19 of lettuce, 3 of onions, 16 of peas, 1 of ruta-bagas, 13 of radishes, 1 of squashes, and 14 of tomatoes. Wakefield, Henderson's Succession, All Seasons, Henderson's Early Summer, and Early Flat Dutch are recommended as good early cabbages for market gardeners.

Tests of implements and materials.—Brief notes on tests of a seed drill, "powder gun," spraying apparatus, plant bed cloth, "roach destroyer," and moth crystals.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

DIVISION OF CHEMISTRY.

BULLETIN NO. 28.

PROCEEDINGS OF THE SEVENTH ANNUAL CONVENTION OF THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS (pp. 238, illustrated).—This is edited by Dr. H. W. Wiley, secretary of the Association, and includes a full report of the meeting held at Washington, D. C., August 28–30, 1890, together with a statement of the methods of analysis of commercial fertilizers, foods and feeding stuffs, dairy products, fermented liquors, and sugars, as adopted by the Association for 1890–91.

FARMERS' BULLETIN NO. 3.

CULTURE OF THE SUGAR-BEET, H. W. WILEY (pp. 24, illustrated).—This treats of the climatic conditions, soil, fertilizers, and cultivation required by the sugar-beet, cost of growing, time of harvesting, and method of ensiling; describes briefly the process of beet-sugar manufacture; and gives statistics of sugar production and consumption.

DIVISION OF STATISTICS.

ALBUM OF AGRICULTURAL GRAPHICS.—A series of colored maps each illustrating the average value and yield of a single crop, by States, during a period of 10 consecutive years. The crops are corn, wheat, oats, rye, barley, buckwheat, potatoes, tobacco, cotton, and hay. There is also a brief prefatory discussion of the values of farm crops, with special reference to the differences in the value of the same crop in different States.

[For example], the extremes in value per acre of corn are $24.32 and $6.19. Eighteen States and Territories average above $15. Half of these are east of the Alleghanies and north of Delaware; the other half on the Pacific coast and in the Rocky Mountain region. In the former the cause is found in large yield and high prices, both the result of demand for consumption by a large proportion of the population engaged in non-agricultural industries. In the latter the climate is not so well suited to maize, and

mining and manufacturing stimulate demand. Where prices are lowest there is either an excessive production or a very low rate of yield. It requires nearly 4 acres in South Carolina to equal the value of one in New Hampshire, though the soil of the former is inferior to that of the latter; and it requires more than 3 acres in Nebraska, which makes the highest average rate of yield, to produce the value of one in the Granite State. These divers results depend far more upon inequalities in distribution of population, and especially in the ratio of consumers to producers, than upon climate or soil. In wheat and other cereals, potatoes, hay, and all farm products of general geographical distribution, similar differences are found to result from similar causes.

REPORT NO. 82 (NEW SERIES), MARCH, 1891 (pp. 57-104).—This includes articles on the distribution and consumption of corn and wheat, agricultural contributions to international commerce, comparative statistics of wheat exportation, legal weights per bushel in the different States, European crop report for March, and the freight rates of transportation companies.

The wheat crop of the world for 1890 is estimated to have been 2,203,889,552 bushels. North America produced 438,493,412; South America, 60,271,043; Europe, 1,316,177,644; Asia, 307,552,000; Africa, 38,915,322, and Australia, 42,480,131 bushels. The six leading countries were the United States, 399,262,000; France, 338,902,124; India, 235,345,600; Russia in Europe, 197,739,200; Hungary, 165,345,000; and Italy, 126,640,746 bushels.

DIVISION OF VEGETABLE PATHOLOGY.

FARMERS' BULLETIN NO. 4.

FUNGOUS DISEASES OF THE GRAPE AND THEIR TREATMENT, B. T. GALLOWAY (pp. 12).—The downy mildew, powdery mildew, black rot, and anthracnose are briefly described; directions are given for the preparation of the simple solution of copper sulphate, Bordeaux mixture, ammoniacal solution of copper carbonate, and eau celeste; methods of treatment are outlined; and the cost of using the fungicides is estimated.

DIVISION OF ENTOMOLOGY.

BULLETIN NO. 7.

THE PEDICULI AND MALLOPHAGA, H. OSBORN (pp. 56, illustrated).—This includes descriptive notes on the species affecting man and the lower animals. The bulletin is illustrated with 42 figures, 22 of which are original. Technical descriptions are given of the following new species: louse of the field mouse (*Hæmatopinus acanthopus*, Burm.), louse of the flying squirrel (*H. sciuropteri*, n. sp.), louse of the fox squirrel (*H. antennatus*, n. sp.), louse of the white-footed mouse (*H. hesperomydis*, n. sp.), louse of the ground squirrel and chipmunk (*H. suturalis*, n. sp.), sucking louse of the pocket gopher (*Hæmatopinoides squamosus*, n. sp.), and louse of the pocket gopher (*Trichodectes geomydis*, n. sp.).

ABSTRACTS OF REPORTS OF EUROPEAN INVESTIGATIONS.

Chemical analyses of soil, J. Sebelien (*Landw. Versuchs-Stationen*, 38, *p.* 342).—This is a paper read before the section for agricultural chemistry and experimenting at the meeting of naturalists (*Naturforscher-Versammlung*) in September, 1890, at Bremen. A series of experiments was begun in 1869 on the experimental fields of the government agricultural high school at Aas, Norway, to observe the effects of a one-sided application of fertilizers in the continuous culture of the same plant for a term of years. These experiments were concluded in 1889, having extended over 21 years.

Barley was grown on nine plats, seven of which received ammonium sulphate, superphosphate, and potassium sulphate, singly, two by two, and all three combined, the other two remaining unmanured. Each year the amount of each of the important fertilizing ingredients removed from the soil with the crop of barley was calculated from Wolff's tables, and a one-sided replacement was made of the amount of one or more of these ingredients removed the previous year, following the plan laid down for the different plats in the first year's application. Thus, to the plat which had received nitrogen as ammonium sulphate the first year, the total theoretical amount of nitrogen removed in the crop each succeeding year was restored in the fertilizer, but not the potash and phosphoric acid; and to the one which had received superphosphate and potassium sulphate the first year, the calculated amounts of phosphoric acid and potash removed were restored. The results of the 21 years' experiment showed the following:

(1) A one-sided application of nitrogen gave a noticeable increase in the crop over the unfertilized plats.

(2) The application of potash exclusively gave no larger crops than where no fertilizer was used.

(3) The three plats which received two of the important elements of plant food each all gave increased crops over the unmanured plats.

(4) The plat to which the "complete fertilizer" was applied showed a very considerable increase over all other plats.

Regarding the proportion of grain to straw, the use of no fertilizer or of potash alone tended to increase the proportion of straw to grain;

while the use of either nitrogen or phosphoric acid alone, and particularly of the "complete fertilizer," increased the proportion of grain to straw and chaff.

Experiments with potatoes gave similar results, except that contrary to the above, potash used alone had a beneficial effect on the yield.

At the close of this series of experiments in 1889, the soil from each plat was analyzed chemically. According to these analyses, the soil from the plats which had received no fertilizer for 21 years contained as much nitrogen as that from those which had received yearly applications of nitrogen. The solution for the estimation of phosphoric acid and potash were made by extracting the samples of soils with 4 per cent hydrochloric acid. These extracts of the soil from the unfertilized plats contained just as much phosphoric acid and more potash than that from the fertilized plats. In the opinion of the author, the chemical analysis of a soil at the present stage of knowledge is no reliable criterion as to its needs.

Exceptions were taken by several of the gentlemen present to the method employed for dissolving the phosphoric acid and potash, it being urged that a 4 per cent hydrochloric acid solution might be insufficient in some cases, especially where considerable quantities of lime, iron, etc., were present.

The water-soluble phosphoric acid compounds in superphosphates, J. Stoklasa (*Landw. Versuchs Stationen*, 38, *pp.* 197–225).—In his investigations the author used pure preparations of monocalcic phosphate, believing that from the results obtained in this way more accurate and reliable deductions concerning the relations between phosphoric acid and the constituents of the soil could be made than by working with superphosphates which contain the soluble phosphoric acid in a more changeable form. He found that a preparation of monocalcic phosphate so nearly pure as to contain only 0.014 per cent of free acid absorbed almost no water (0.2 per cent) from the air by lying for 37 days, while a preparation containing 9.9 per cent of free phosphoric acid absorbed, under exactly the same conditions, 9.3 per cent of water. A preparation containing 0.1 per cent of free acid is somewhat hygroscopic, and this quality increases with the increased content of free acid.

When these two preparations were dried in an oven at 15–20° C., the chemically pure preparation readily gave up its small amount of water and gained its former weight; but after heating the other sample (containing 9.9 per cent free acid) at the same temperature for 20 days, it still contained 8.14 per cent of water. When the water was expelled from both preparations they were found to contain exactly the same amounts of free phosphoric acid as before, showing that the water absorbed from the air had caused no decomposition of the salt in either case; in other words, that monocalcic phosphate is a stable compound in the air. Steam (80–85° C.) was found to decompose the salt, causing phosphoric acid to be set free.

The author believes that the differences in the hygroscopic action of superphosphates may often be explained by the differences in the amount of free phosphoric acid they contain, and he further states that superphosphates made with sulphuric acid of 50° Baumé contain four or five times as much free phosphoric acid as those made with 60° acid.

Various opinions have been expressed as to the solubility and the decomposition of monocalcic phosphate in water.* To further study this question, weighed quantities of distilled water and the salt in different proportions were shaken together in a flask at 150° C. for 15 minutes; the solution was filtered, total and free phosphoric acid and lime were determined in the filtrate, and the contents of the filter were dried and weighed.

In the proportion of 1 : 1 (20 grams monocalcic phosphate to 20 c. c. water) 26.34 per cent of the salt was decomposed, the products being free acid (7.51 per cent) and crystallized dicalcic phosphate; the latter remained upon the filter and was equal to 14.53 per cent. The rate of decomposition diminished as the proportion of water to monocalcic phosphate was increased. Thus, with 5 grams of salt to 500 c. c. of water (1 : 100), 0.95 per cent of the salt was decomposed, 0.50 per cent of free acid being formed, and 0.77 per cent of dicalcic phosphate separating out. At 1 : 200 no free acid could be recognized; the solution remained clear (no dicalcic phosphate separated out), and consequently there was no evidence of a decomposition of the salt. The author suspects, however, that decomposition took place to a slight extent.

Various experiments, in which the products of decomposition of the salt were allowed to stand for a longer or a shorter time, with frequent shaking, indicated that no monocalcic phosphate was reformed from the freed phosphoric acid and dicalcic phosphate; but when the solution made by shaking monocalcic phosphate with water was diluted, monocalcic phosphate was reformed from the dicalcic salt and the free acid and no trace of free acid could be found.

To recapitulate briefly, monocalcic phosphate is not decomposed by lying in the air, even when it absorbs water from the air in considerable quantities. Monocalcic phosphate is decomposed by water at ordinary temperature; in a concentrated solution the decomposition is energetic; in the proportion 1 : 200 it is so slight that it can not be recognized. The solubility of monocalcic phosphate is dependent on the amount of free phosphoric acid present, and this salt is dissolved in water without decomposition only when it contains an amount of free phosphoric acid corresponding to the amount which would be formed by the decomposition of pure monocalcic phosphate. The properties of monocalcic phosphate containing free phosphoric acid are of particular interest in the study of superphosphates and of the changes

* E. Erlenmayer, Verhandlungen d. math. phys. Klasse d. k. bayer. Akademie, 1872, p. 269; Ber. d. d. chem. Gesell., 1876, p. 1839; H. Wattenberg, Ber. d. d. chem. Gesell., 9, p.1839; Journ. f. Landw., 1879; H. Otto, Zeitschr. f. angew. Chem., 20 (1887), p. 208, etc.

occurring in plant food. Numerous trials have shown that 20 grams of superphosphate may be dissolved in 1,000 c. c. of water without difficulty. This is true, provided the superphosphate contains sufficient free phosphoric acid, which is the case when 50° Baumé acid has been used in its manufacture. Disuperphosphates (dicalcic phosphate) contain some free phosphoric acid directly after their formation, but this soon combines with the undecomposed tricalcic phosphate. The more free phosphoric acid a superphosphate contains the less will it be decomposed by the action of rains. The action of the phosphoric acid set free by the decomposition of the salt depends upon the conditions in the soil. The dicalcic phosphate formed in nearly all of the processes is dissolved by water with the aid of organic and inorganic acids. The author further states, although the data which lead to the conclusion are not presented in the article, that in soils which do not contain any considerable amounts of ferrous and ferric oxides the free phosphoric acid changes to a form available to the roots and plays no unimportant part in the nourishment of plants.

The nutritive value of cellulose, W. Henneberg and F. Lehmann (*Landw. Versuchs-Stationen*, 38, *p.* 337).—A paper read by Dr. Lehmann before the section of the meeting of naturalists above referred to. In two series of experiments, each of several months' duration, two sheep were fed a basal ration consisting of bean meal, barley meal, pea-nut cake, and oat straw. To this were added sugar (either cane sugar or glucose), and crude fiber prepared from rye straw by the action of sodium hydroxide solution, each in long periods and in such a way that each sugar period and each cellulose period was preceded and followed by a period in which the basal ration was fed alone.

The results of the two trials indicated that cellulose prepared as stated above, was nearly or quite equal in value as an albuminoid conserver to the easily soluble carbohydrates. The second experiment, in which the carbonic acid and marsh gas given off by the animals were determined by means of a Pettenkofer respiration apparatus, showed that the amount of marsh gas given off by ruminants may be very high. Nearly 10 per cent of the total carbon exhaled was in the form of this gas. The production of carbonic acid and marsh gas was increased when sugar was added to the basal ration, as well as when cellulose was added. This indicates that the marsh gas exhaled does not come exclusively from the digestion of the cellulose of the food, but probably from that of other carbohydrates also.

The author is led from these experiments to believe that cellulose affects the production of fat as well as the albuminoid metabolism.

Changeability of the fats of certain feeding stuffs, O. Reitmair (*Landw. Versuchs-Stationen* 38, *pp.* 373–400).—The object of the investigation here reported was to get light upon the changes which occur in the fats of oil-cake and kindred feeding stuffs. The importance of the subject is not

inconsiderable, since oil-cakes of various kinds are much used as food for stock, and they are liable to be of inferior quality because of carelessness in their manufacture or storing. To the oil producer the quality of the residue he sells for farmers' use is a minor matter. To insure the making of the best oil-cake for feeding purposes and to avoid deterioration of the product before using, a more thorough understanding of the chemical changes of their oily and fatty constituents is essential. One of the facts to be met is that in these changes, which are manifest in rancidity and other objectionable ways, the action of ferments is a prominent factor.

The article contains an account of studies of pea-nut oil, both the expressed oil and that in the nuts and the press-cakes, with reference to the acid equivalent (amount of free fatty acids), the iodine number, and the saponification equivalent. Pea-nut oil consists principally of the glycerides of palmitic, arachic, and hypogæic acids.

Acid equivalent.—The free fatty acids were determined by titrating a solution of these materials in alcoholic ether (free from acid). with a solution of alcoholic potassium hydroxide (one quarter to one half normal), using phenolphthalein as an indicator. The acid equivalent or expression for the number of mg. of KOH required per gram of fat, was determined for pea-nut oil expressed and extracted from both fresh and old nuts and press-cakes, and that from various sources. The variations in acid equivalent were, for the fat extracted or expressed from pea-nuts, 1.5 to 32.3, and for that from pea-nut cake 18 to 166. The more important points brought out by these determinations were, in brief, as follows: The fat of some pea-nut cakes undergoes more rapid changes than that of others, depending upon the nuts from which the cake comes, the method and thoroughness of the extraction of the oil, the manner of storing, etc. Press cake from which the oil has been very thoroughly expressed does not keep as well, with regard to the fat, as that containing more oil. It was noticeable throughout the investigation that the cakes which contained the most free fatty acids were low in fat content, as is illustrated by the following results:

Acid equivalent.	Percentage of fat.
47.1	12.81
56.5	9.81
99.4	8.24
156.4	6.57
158.7	6.38
166.0	6.29

This leads the author to believe that a thorough expression of the fat offers more favorable conditions for the formation or elaboration and spread of the ferment ("probably organized ferments") which causes the decomposition of the fats. It is thought this may be due to a more extensive breaking up of the cellular structure or to the increased

capacity for absorbing moisture from the air, or to the removal of large quantities of fat, for a considerable amount of fat remaining behind in the press-cake may present a mechanical hindrance to the spread of the ferment through the cake. Although the protein content of the press cake is raised by thorough expression of the fat, the cake would then be of less value to the farmer on account of its decreased keeping qualities.

In general, the presence of a large amount of free fatty acids in pea-nut cake can not be taken as indicating a spoiled or bad condition. On the contrary, the worst and poorest preserved pea-nuts, and in particular those which had a rancid odor, gave a low acid equivalent.

Directly after the expression of the oil from pea-nuts, the fat remaining in the press-cake has the same content of free acids as that of the oil in the pea-nuts. This acid content of the fat increases in the pea-nut cake rapidly, but irregularly, so that a determination of the free fatty acids present gives no indication as to the age of the cake, or the condition or age of the pea-nuts or from which it was derived.

Iodine number.—The iodine number, or the expression for the amount of iodine absorbed by fat, is said to furnish an indication of the amount of hypogæic acid present in pea-nut oil. According to Benedikt* hypogæic acid forms white, needle-shaped crystals which when exposed to the air turn brown, forming volatile, rancid-smelling fatty acids. The more hypogæic acid lost from pea-nut oil, then, the lower will be the iodine number. The author found that the glyceride of hypogæic acid, similar to the acid itself, undergoes changes by which the iodine number is decreased. This fact calls attention to the necessity of drying both the material taken for analysis and the ether extract in an atmosphere of some indifferent gas, to prevent the escape of the glyceride of hypogæic acid. In several trials in which both ground pea-nuts mixed with sand and the fat extracted from the same were dried in carbonic acid, hydrogen gas, and air, there was a considerable difference between the iodine number in the materials dried in the air and that dried in the hydrogen gas. The results of determinations of the iodine number in the same sample agreed more closely among themselves and were higher where hydrogen was used. In various determinations, the older and poorer the pea-nuts, and the stronger the rancid odor, the lower was the iodine number. The iodine number ranged in the fat of pea-nuts from 62.7 to 98.5, and in that of pea-nut cakes from 40 to 80.1. The author believes that the iodine equivalent of fat obtained by extraction will be little if any lower than that of oil expressed from the same pea-nuts; and that the determination of the iodine number in fat obtained by extraction under exclusion of oxidizing influences offers a means of judging whether a pea-nut cake has been made from fresh, good pea-nuts, or whether the fat of the same has undergone changes either in the manufacturing process or by storing the cake. Press-cake

* Analyse der Fette, p. 14.

from old and spoiled nuts, or which has been improperly stored, will show a lower iodine number. The rancid condition of the fat is expressed in a reduction of the iodine number.

Saponification.—In general it may be assumed that a fat will show a high saponification equivalent the greater the changes it has undergone. The method used for determining this equivalent was as follows: After titrating the solution of fat in alcoholic ether to determine the free fatty acids, an excess of potassium hydrate was added, and the solution heated on a boiling water bath for an hour. An excess of hydrochloric acid was added after the saponification, the solution titrated back with standard alkali solution, using phenolphthalein as indicator, and then strongly diluted with water to show that the saponification had been complete. The indications furnished by the determination of the saponification equivalent were not so pronounced and strong as those of the iodine number or acid equivalent. It is thought, however, to be of use as an indicator in some cases, and is more rapidly and easily carried out and requires less preparation than the iodine absorption.

Conclusions.—The conclusions from the above studies are given as follows:

The pea-nut oil is very changeable. The fresh oil is nearly colorless, clear, thin, has a faint but pleasant odor and taste, and contains no free fatty acids. The saponification equivalent is lowest and the iodine number the highest in the fresh oil. The expressed oil changes only slowly and slightly. When freely exposed to the light for a long time it becomes thick and rancid and shows then a lower iodine number and a higher saponification equivalent, together with a slight increase of the acid equivalent.

The fat in pea-nuts changes very little with the age of the nut, in case the outer shuck has not been broken; and the broken nuts show only a low content of free fatty acids after lying for years. A noticeable increase of the saponification equivalent and a decrease of the iodine number occurs only with old and spoiled nuts, which look bad and have a rancid smell. The greatest changes occur in the fat of the pea nut cake, and this change reaches the maximum in cake containing a low percentage of fat. The acid equivalent in particular increases rapidly; the iodine number may decrease one third, particularly when old and spoiled nuts have been used, and in this case the saponification equivalent is increased.

For judging of the freshness of pea-nut cake (as indicated by the reactions of the fat) the first indication is furnished by the appearance of the extracted fat. If it is solid at ordinary temperature, large quantities of free fatty acids are present, and in proportion as the fat contains less of these it is softer. The extraction is to be made with great care. The iodine number is the best indicator as to the freshness of pea-nut cake and the condition of materials from which it came.

Bacteria of normal and abnormal milk, L. Adametz (*Nos.* 1–3, *Oesterreich. Monatssch. für Thierheilkunde*, 1890).—This is a review of our present knowledge in regard to bacteria in milk. The author first points out that since milk is free from bacteria when drawn from the cow the number present in milk which is immediately consumed is likely to be so small as to render them of no significance. But when milk is allowed to stand for a while before being used the bacteria increase marvelously. In such milk there is a great variety of bacteria, which produce changes resulting in various forms of abnormal milk. Normal milk, according to Adametz, has the following characters: when freshly milked it has a characteristic taste and odor and an amphoteric reaction; it is readily coagulated by rennet, and if left to itself will become acid after from 2 to 4 days, and will eventually curdle. Any milk which shows other characters than these is regarded as abnormal milk.

Four different ways in which milk curdles abnormally are distinguished as follows: (1) The casein becomes jelly-like and a layer of cloudy liquid soon appears between the curd and the surface layer of cream. The casein soon dissolves and the liquid increases. (2) The casein is precipitated as a compact mass with a little cloudy liquid between the curd and the cream. (3) The casein becomes flaky and collects at the bottom of the vessel in which it is contained. It soon becomes more or less dissolved into a liquid. (4.) A fermentation appears at the same time with the curdling, which breaks up the curd and causes a mixing of the ingredients of the milk so that there is formed a compact, fermented mass containing much fat, while a clear liquid appears at the bottom of the vessel.

The bacteria which are commonly found in milk are divided by the author into two classes, according to their effects. One class changes the milk sugar into lactic acid, which soon curdles the milk. The typical species of this class is one commonly known as the sour milk bacillus (*Bacillus acidi lactici*). This is certainly a common form, although many other species of bacteria have the same effect, even some of the pathogenic bacteria thus producing lactic acid. The second class produces a curdling of the milk by the formation of rennet-like ferment, and the curdling of the milk is soon followed by a solution of the curd. Bacteria of this class render the milk slightly alkaline or do not affect its reaction. This class comprises a large number of species, most of which have the further character of liquefying gelatine. Many of them produce spores which resist a high heat. The fermentations which occur in boiled milk are usually caused by bacteria of this class, since the boiling kills all of the acid-forming species. They produce a marked decomposition of milk, giving rise to peptones, leucin, tyrosin, and many other products. There seem to be two distinct ferments (enzymes) produced by these bacteria; one, like rennet, curdles the milk, and the other, like trypsin, has the power of peptonizing the casein. Ordinarily their presence in milk is so disguised by the acid-forming species that they

are of no importance. In the ripening of cheese, however, this class of bacteria is of great significance.

In addition to these common forms of bacteria other species are occasionally present which give rise to certain forms of diseased milk. Three distinct species of organisms are known to produce red milk. One much studied bacterium gives rise to blue milk. Three species are known to curdle the milk and then rapidly dissolve the curd into a yellow liquid of various degrees of brilliancy. Four different species have been found which produce a slimy milk. These have been described by different observers and have been found in different places Adametz has himself found one of the slime forming species in the waters of brooks. Besides these well-marked troubles a miscellaneous series of "milk diseases" very annoying to cheese-makers, are mentioned, and their origin is found in the growth of various bacteria and yeasts.

Special attention is given to alcoholic fermentation of milk known as "kefir." This form of fermented milk is a favorite beverage among the people of the Caucasus Mountains, and is produced by putting into the milk small bodies known as "kefir grains." The fermentation has been found to be the result of a complicated growth of bacteria and yeasts. Several species of bacteria and several yeasts have been found in these kefir grains and in the fermenting milk. Among the bacteria are a number of the peptonizing species, and some which have the power of inverting sugar. The common form of yeast familiar to the beer maker (*Saccharomyces cerevisiæ*) has not been found in this connection. The alcoholic fermentation is the result of the combined action of these organisms, but the share taken by each has not yet been determined.

In addition to these bacteria, which produce troublesome, though comparatively harmless effects in milk, certain species which are injurious to the consumer occasionally get into the milk. Some of the common putrefactive bacteria give rise to poisons while growing in milk. These poisons are in general known as ptomaines, and when taken into the stomach of the person who drinks the milk or eats the cheese, produce various dangerous symptoms and occasionally death. The best known of these poisons connected with milk is tyrotoxicon. Several species of bacteria have been studied which can thus infect the milk with poisonous material. The poisoning from this source is especially common from cheese. Accounts of over 300 cases of such poisoning were collected by Professor Vaughan in two years.

Milk is also an excellent nourishing medium for several of the pathogenic germs. This is especially true of sweet milk, sour milk offering a less favorable medium for their growth. Some of them grow readily in milk without producing any visible effect. The germs of typhoid fever, tuberculosis, and diphtheria may thus grow without indicating their presence by any external changes in the milk. Adametz thinks that typhoid fever is frequently spread by means of the milk supply

and gives the details of an interesting case where the epidemic could be traced to milk. The author also thinks that milk is one of the most common means of distributing tuberculosis. The great prevalence of this disease among cows he attributes to their abnormal life in stalls, and he gives statistics in regard to the percentage of tuberculous cows in various provinces in Germany and also in New York. The milk of tuberculous cows certainly contains the tuberculosis bacillus, and thus milk is made a possible cause of the spread of this disease. Cholera germs will readily grow in milk when introduced, as they sometimes are, through water that is added to the milk. Cases of cholera have been positively traced to milk. Scarlet fever is frequently connected with the milk supply, and the author cites some interesting cases in illustration of this fact. As a source of distribution of certain diseases among animals milk also takes a foremost rank. The distribution of the swine plague by this means is especially discussed.

Lastly, the author asks: What is the source of the numerous bacteria which find their way into the milk? Their ultimate source is the earth, air, or water, but the methods by which they get into the milk are four: (1) Some of them get in during the milking from the hands of the milker or from the duct of the milk gland. (2) Many are derived from the germs which remain in milk vessels that have not been properly cleaned. (3) Many get in from the air of the stall, which is always well supplied with bacteria. (4) Many may be added with the water used to dilute the milk. It is in this way that the germs of typhoid fever and cholera are most likely to get into milk.

The author thinks that the diseased cow must be regarded as one of the sources of the infection of milk, for although no bacteria succeed in getting through the healthy mammary gland into the milk, it is certain that when the cow is diseased, especially if the milk gland itself shares in the disease, the milk may be contaminated with bacteria, even when first drawn from the cow.

Determination of water in butter, O. Henzold (*Milch Zeitung*, 1891, *pp.* 71, 72).—The addition of small pieces of pumice stone to the sample of butter taken for drying is recommended. The pumice stone absorbs the melted butter fat and enables it to give up its moisture much more readily.

Twenty grams of pumice stone, previously ignited and cooled in a desiccator, are weighed out in a porcelain dish, with 10 to 12 grams of butter and a small stirring rod. These are heated until the butter is melted, and stirred until it has been absorbed by the pumice stone. If more than 10 to 12 grams of butter are taken they will not be entirely absorbed by the 20 grams of pumice stone, and the moisture will consequently given up less readily. The melted and absorbed butter fat is dried in a bath at 100° C. during 2 hours and weighed. It is not advisable to dry for a longer time, as the experience of the author indicates that after 2 hours the butter commences to increase in weight.

The result of several comparisons of this method with that of drying in a glass with frequent stirring showed that practically the same results were obtained by the pumice-stone method in 2 hours as with the other in 5 hours.

To determine whether the water contained in a sample of butter is entirely expelled by heating with pumice stone for 2 hours, clear, filtered, and thoroughly dried butter fat was mixed with whey containing 3 per cent of common salt, the water content of which had been carefully determined. Samples of this mixture containing about 11 grams of butter fat each were dried with and without the addition of pumice stone. The sample to which pumice stone had been added was dried to a constant weight and had given up the calculated amount of water at the end of 2 hours, while that dried by itself required 6 hours.

EXPERIMENT STATION NOTES.

CENSUS BULLETIN NO 11, MARCH 19, 1891 (pp 12).—A preliminary report on truck farming, by J. H. Hale. "Upward of $100,000,000 are invested in this industry, the annual products reaching a value of $76,517,155 on the farms after paying freights and commissions, realized upon 534,440 acres of land. There are employed in this industry 216,765 men, 9,254 women, and 14,874 children, aided by 75,866 horses and mules, and $8,971,206.70 worth of implements."

COLORADO COLLEGE AND STATION.—C. L. Ingersoll, M. S., has resigned his position as president of the college and director of the station, and has been elected professor of agriculture at the Nebraska University, and will act as station agriculturist. After June 1 mail should be addressed to him there. Walter J. Quick, B. S., has been appointed professor of agriculture in the college and agriculturist to the station. B. C. Buffum, B. S., assistant in irrigation engineering and meteorology, has resigned to become agriculturist and meteorologist of the Wyoming Station. R. H. McDowell, B. S., assistant agriculturist, has resigned to become agriculturist and meteorologist in the Nevada Station. A new substation, located at Divide, was opened March 1, in charge of G. F. Brenninger.

CONNECTICUT STORRS STATION.—In the station staff as reorganized C. D. Woods, B. S., is vice-director and chemist; C. S. Phelps, B. S., agriculturist; H. B. Gibson, B. A., assistant chemist; E. A. Bailey, assistant agriculturist; and C. B. Lane, assistant in farm experiments. Mr. Phelps has also been elected professor of agriculture in the Storrs School.

ILLINOIS STATION.—Hon. La Fayette Funk, of Bloomington, Illinois, who has succeeded G. S. Haskell as president of the State board of agriculture, has also taken his place on the governing board of the station. E. H. Farrington, M. S., has been appointed chemist of the station, and has taken the place of C. Bennett, M. A., on the governing board. E. K. Nelson has been made assistant chemist.

MICHIGAN STATION.—Arthur G. Blackstein, M. D., who was appointed pathologist of the station, as mentioned in Experiment Station Record, Vol. II, p. 466, has declined the appointment, having decided to spend two years more in Germany.

MINNESOTA STATION.—N. W. McLain, LL. B., has resigned the directorship of the station. E. F. Batten served as acting director until the appointment of C. D. Smith, M. S., as director.

NEW HAMPSHIRE COLLEGE AND STATION.—The prospect of the removal of the college and station in the near future will prevent additions to buildings or radical changes in lines of work. Entomology is to be made a prominent feature of the work of the station.

NEW YORK CORNELL STATION.—The board of trustees at its last meeting decided to largely increase the plant of the dairy and the provisions both for instruction and for experimenting in dairy husbandry. The scheme contemplates the organization of a department of dairy husbandry and animal industry, with the appointment of a professor and the enlargement of the course of instruction to extend throughout the year. Original investigation and experimentation will be strong features of the instruction. C. D. Smith, M. S., who recently accepted the position of director of Arkansas Station, has since become director of the Minnesota Station.

UTAH STATION.—Dynamometer tests of the draft of sleighs and sleds have been completed. It was found that under average conditions of sleighing the draft of the sleigh was greater than that of the wagon on bare roads. The draft was less when the load was placed on the front end of the sled than when placed on the rear end, which is the reverse of what was found to be true of the wagon. The angle of draft or the point of attachment to the sled made no difference in the draft.

STATION AT RIGA, RUSSIA.—This Office has received from Prof. G. Thoms, director of the agricultural-chemical experiment and seed-control station connected with the Polytechnic Institute at Riga, Russia, the following publications issued by him in the German language: *Die landwirthschaftlich-chemische Versuchs- und Samen-Control-Station am Polytechnikum zu Riga, Berichte über deren Thätigkeit in den Jahren* 1872–86; *Das Wasser in der Bierbrauerei* (1878); *Die Ackerböden des Kronsgutes Peterhof* (1880); *Die künstlichen Düngemittel* (1881); *Ueber die neuesten Fortschritte auf dem Gebiete der Spiritusfabrication* (1881); *Offener Brief über die Ergebnisse der Dünger-Controle*, 1881–82; *Zur Kleeseidefrage* (1884); *Randbemerkungen über Bearbeitung und Düngung des Bodens* (1884); *Brauerei-Versuchs Station* (1884); *Erläuterungsbericht* (of two charts on soil analysis exhibited at Vienna, 1890); *Ergebnisse der Dünger-Controle* (1886–90); *Ueber den drei-jährigen Düngungs-Versuche zu Roggen, Gerste, und Hafer* (1888–90).

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

APRIL 1 TO MAY 1, 1891.

Report of the Secretary of Agriculture for 1890.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, Vol. II, No. 8, March, 1891.

Experiment Station Record, Vol. II, No. 9, April, 1891.

DIVISION OF ENTOMOLOGY:

Bulletin No. 7.—The *Pediculi* and *Mallophaga* Affecting Man and the Lower Animals.

Periodical Bulletin, Vol. III, No. 6, March, 1891.—Insect Life.

DIVISION OF VEGETABLE PATHOLOGY:

Circular No. 10.—Treatment of Nursery Stock for Leaf-Blight and Powdery Mildew.

DIVISION OF STATISTICS:

Report No. 83 (new series), April, 1891.—Report on the Condition of Winter Grain, the Condition of Farm Animals, and on the Freight Rates of Transportation Companies.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

APRIL 1 TO MAY 1, 1891.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Third Annual Report, 1890.

Bulletin No. 23 (new series), February, 1891.—Co-operative Soil Tests; Meteorology.

Bulletin No. 24 (new series), February, 1891.—Dairying and Breeding; Meteorology.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF CALIFORNIA:

Bulletin No. 92, March, 1891.—Notes on California Olives; their Adaptations and Oils.

CONNECTICUT STATE AGRICULTURAL EXPERIMENT STATION:

Annual Report, 1890.

Bulletin No. 106, March, 1891.—Babcock's Milk Test; Fertilizers.

Bulletin No. 107, April, 1891.—The Connecticut Species of Gymnosporangium (Cedar Apples).

STORRS SCHOOL AGRICULTURAL EXPERIMENT STATION:

Third Annual Report, 1890, Part I.

DELAWARE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 11, January, 1891.—Soil and Crop Tests.

Bulletin No. 12, March, 1891.—Injurious Insects and Insecticides; Spraying Machinery.

INDIANA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 34, Vol. II, February, 1891.—Sugar-Beets; Field Experiments with Commercial Fertilizers and Manure on Barley and Oats; Tests of Vegetables.

Bulletin No. 35, Vol. II, March, 1891.—Loose Smut of Oats.

KENTUCKY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 32, March, 1891.—Strawberries; Vegetables.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:

Eighth Annual Report, 1890.

Analyses of Commercial Fertilizers, March, 1891.

Bulletin No. 39, April, 1891.—Treatment of Fungous Diseases.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meterological Bulletin No. 27, March, 1891.

Bulletin No. 12, April, 1891.—Report on Insects.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF MINNESOTA:

Biennial Report, 1889–90.

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION:

Third Annual Report, 1890.

Bulletin No. 14, March, 1891.—Injurious Insects.

NEBRASKA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 16, April, 1891.—Experiments in the Culture of the Sugar-Beet in Nebraska.

NEVADA AGRICULTURAL EXPERIMENT STATION:

Third Annual Report, 1890.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 26, March, 1891.—Experiences with Egg-Plants.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 74*a*, December, 1890.—Meteorological Summary for North Carolina, December, 1890.

Bulletin No. 74*b*, January, 1891.—Meteorological Summary for North Carolina, January, 1891.

OREGON EXPERIMENT STATION:

Bulletin No. 9, February, 1891.—Silos and Silage.

Bulletin No. 10, April, 1891.—Experiments with Codling Moth and with a Combined Fungicide and Insecticide; Descriptions of Spraying Apparatus; Notes on the Hop Louse.

Bulletin No. 11, May, 1891.—Notes on Grasses and Potatoes.

PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 15, April, 1891.—Influence of Variety and of Rate of Seeding on the Yield of Ensilage Corn.

RHODE ISLAND AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 9, December, 1890.—Experiments in Apiculture.

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 21, February, 1891.—Experiments with Small Grains.

Bulletin No. 22, March, 1891.—Injurious Insects.

Bulletin No. 23, April, 1891.—Forest-Trees, Fruits, and Vegetables.

TEXAS AGRICULTURAL EXPERIMENT STATION:

Third Annual Report, 1890.

Bulletin No. 13, December, 1890.—Value of Sorghum as a Feeding Stuff and its Effect on Soil; Analyses of Teosinte at Different Stages of Growth; Miscellaneous Analyses.

AGRICULTURAL EXPERIMENT STATION OF UTAH:

Bulletin No. 5, March, 1891.—Potato Trials.

VERMONT STATE AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 23, March, 1891.—Fertilizers.

WEST VIRGINIA AGRICULTURAL EXPERIMENT STATION:

Third Annual Report, 1890.

Bulletin No. 11, September, 1890.—Meteorology and Reports on the Condition of Crops.

Bulletin No. 12, December, 1890.—The Canada Thistle.

DOMINION OF CANADA.

DEPARTMENT OF AGRICULTURE:

Reports of the Officers of the Canadian Experimental Farms for 1890.

GUELPH AGRICULTURAL COLLEGE:

Bulletin No. 59, March, 1891.—Green Fodder for Swine.

Bulletin No. 60, March, 1891.—Growth and Uses of Rape.

EXPERIMENT STATION RECORD.

Vol. 2. JUNE, 1891. No. 11.

EDITORIAL NOTES.

The horticulturists of the stations are rightly not content to make the testing of varieties the most prominent feature of their work. It is in fact far from the highest form of experimenting and can not be expected to yield definite and satisfactory results except in narrow lines rationally and patiently worked out. Many of the experiments in methods of culture of various plants are also of very little consequence unless they are planned with reference to certain ulterior ends. The broad basis on which the horticultural work of the stations should be placed involves a comprehensive study of the variations and behavior of plants under culture. The influences of soil, climate, fertilizers, methods of culture, treatment in forcing, etc., should be investigated in the hope of discovering the laws of plant variation and amelioration. When these are once known it will be possible to proceed systematically in the origination and fixation of varieties.

One of the most attractive fields for experimentation is that of the crossing or hybridization of plants. This requires considerable knowledge of species and ingenuity in devising methods of procedure, but while the difficulties in the way of success are great, the inducements to undertake the task are very attractive. Even here it will be necessary to plan investigations carefully in order that we may have a reasonable hope of discovering general principles. In this, as in other lines of experimental research, incidental discoveries of great practical value are very likely to be made. Thus experiments in the hybridization of a given kind of plant planned for the study of laws may bring numerous new varieties, some of which may prove to have a high commercial value.

The propagation of plants is also worthy of more thorough investigation. It is probable that improvements might be made in the treatment of almost every species of plants now cultivated. Especially in the case of the larger fruits there is good reason for believing that the best methods of propagation have not been reached. In this line of work the experimenter ought to be a good botanist in the sense of knowing species and varieties, and of being a judge of their merits and limitations.

The species of cultivated plants are very much misunderstood and the horticulturist can not expect to do thoroughly good work until he has definite ideas in regard to specific limitations. For instance, there is much confusion as to the species of raspberries, blackberries, and dew-berries, and as to the relations of these species and the modes of their variation. Yet it is hard to understand how the best scientific work in crossing, ameliorating, or even cultivating these fruits can be done without a careful preliminary study of their species. The horticulturist should not only be a botanist, but be able to apply the principles of botany to the perplexing entanglements of the garden.

The amelioration of our wild fruits is a matter of vast importance in this country. The native edible plants of America present many attractive possibilities to the scientific experimenter, especially in view of the fact that important cultivated fruits, such as the apple, cherry, and plum, do not seem likely to succeed in a large part of the country. This matter has been much discussed, but there is still an opportunity for the stations to devise better methods of experimenting in this line.

The forcing of plants under glass is yearly becoming a more important and profitable branch of horticulture, especially in the Northern States. The construction of forcing-houses is even yet very imperfectly understood, and the methods of forcing, as well as the influence of forcing upon the plants and their offspring, present many interesting problems for further investigation.

Another line of horticultural work which the stations will do well to undertake systematically and thoroughly, is the study of questions relating to the manuring of plants. As much experience has already been gained in similar work with field crops, and as the carefully matured plans already made for co-operative tests with fertilizers applied to the staple crops can very readily be adapted to fertilizer experiments with fruits and vegetables, it has been deemed advisable to propose to the stations to co-operate in such experiments. For this purpose a circular letter (Circular No. 19) has been issued by this Office calling the attention of the stations to this matter and presenting the outlines of plans for co-operative experiments.

The need of thoroughly trained specialists for the work of the experiment stations has been more than once dwelt upon in the publications of this Office. The costly experience which has demonstrated this necessity in the older experiment stations, especially in Europe, is teaching the same lesson in this country. The fact is coming to be appreciated that to get light upon the problems about which the farmers are asking questions, the stations must conduct researches of the kind for which the most advanced scientific knowledge and the most thorough special training are indispensable.

So true is this that even in Germany, where specialties are so fully cultivated, the experiment stations find it difficult to obtain men with the specific training required. At the last meeting of the Association of Agricultural Experiment Stations in the German Empire, held in Bremen in September, 1890, a commission was appointed, consisting of Professors H. Schultze of Brunswick, H. Fresenius of Wiesbaden, J. König of Münster, U. Kreusler of Poppelsdorff (Bonn), and B. E. Dietzell of Augsburg, to take the matter into consideration, and to present a request to the Bundesrath of the German Empire that provision be made for government examination at least of chemists who are to be charged with the examination of food materials. The need of a government examination for chemists as station assistants is regarded as desirable by the majority of German station directors, as appeared from replies to circulars of inquiry sent to a large number of these officers. From the discussion it appeared that the difficulty is that the ordinary training of the universities and technical schools, though excellent in theoretical and general chemistry, is not sufficient to prepare young men for the special kinds of chemical investigation needed in the experiment stations. The instituting of government examination of aspirants for these positions, corresponding to that required of candidates for the higher scientific and educational positions in Germany generally, it was thought would lead the schools to introduce and young men to follow the lines of instruction and inquiry needed.

The kinds of inquiry which our stations are undertaking in chemistry are essentially similar to those in which the German stations are engaged. The problems of plant and animal nutrition, of soil chemistry, and of technology are fundamentally the same here as there, and as high an order of talent and training is needed for their successful study in the United States as in Europe. Certain it is that one of the crying needs of the experiment stations in the United States is for thoroughly trained investigators.

At the same meeting of representatives of the German stations (See page 524 of the present volume of the Experiment Station Record) reports were made by committees on methods of investigation of feeding stuffs. At the last meeting of our Association of Official Agricultural Chemists a report was made by a committee on the improvement of methods of analysis of feeding stuffs, and reports were likewise made upon results of co-operative inquiries during the past year. The interesting fact is that these reports and the accompanying discussions show that both these associations are coming to appreciate the need of more thorough inquiry regarding the chemical constituents of the different kinds of materials used for food and feeding stuffs. The Germans are, however, somewhat in advance of us in that: while they are studying methods of analysis as we are, they have taken more definite steps toward co-operative effort in the study of the specific compounds and classes of compounds occurring in special classes of feeding stuffs.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

Alabama College Station, Third Annual Report, 1890 (pp. 19).

This includes the reports of the treasurer, director, chemist, botanist and meteorologist, and biologist, which contain summaries of bulletins, and outlines of the work of the station.

Alabama Canebrake Station, Bulletin No. 11, February, 1891 (pp. 10).

EXPERIMENTS WITH COTTON IN 1890, W. H. NEWMAN, M. S.

Experiments with fertilizers on "black slough" bottom-land.—This is an account of an experiment with cotton on 11 fifteenth-acre plats of black slough bottom-land: sulphate of ammonia 90 pounds, dissolved bone-black 195 pounds, kainit 150 pounds, and floats 300 pounds per acre, being applied singly or in combination on nine plats, two plats remaining unmanured. The previous year the land had been used for wheat and received no fertilizers. The yields of cotton on each plat are tabulated. "These results simply repeat the indications plainly presented for the last 5 years, viz., that commercial fertilizers are not profitably used upon this class of soil."

Experiments with cotton seed meal on red prairie land.—Of 2 sixth-acre plats used for cotton one received 400 pounds of cotton-seed meal per acre and the other received no fertilizer. The land had been used for oats and peas the previous season. The unmanured plat produced 7.9 pounds more lint and 9.44 pounds more total crop than the plat receiving cotton-seed meal.

Experiments with various fertilizers.—Twelve one-acre plats used for cotton were treated as follows: 2,000 pounds of cotton seed and 400 pounds of cotton-seed meal were each applied on one drained and one undrained plat; 200 pounds of cotton-seed meal in one application, 200 pounds before planting and 200 pounds later, and 18 tons of stable manure (about two thirds sawdust) were each applied to one plat; two plats had a previous 2 years' green manuring, one with pea vines and one with melilotus; one plat, which had been used as a garden for 4 years, received 400 pounds of cotton-seed meal; and two plats, one drained and one undrained, remained unmanured.

The tabulated results show an increased yield with green cotton seed over the unfertilized plats, amounting to 156.5 pounds of lint cotton on the undrained land, and 40.5 pounds on the drained land. The former "paid for the cost of the seed and its application." The increase with cotton-seed meal "did not pay." The yields where pea vines and melilotus had been plowed under were among the highest, the yield with melilotus being 11.5 pounds of lint cotton in excess of that with peas. With the stable manure and sawdust the yield was below the average.

Varieties of cotton.—Tabulated notes on 13 varieties of cotton.

California Station, Bulletin No. 91, February 28, 1891 (pp. 6).

PORT AND SHERRY GRAPES IN CALIFORNIA, E. W. HILGARD, PH. D. (pp. 1–4).—Brief descriptive notes on 6 port-wine varieties and 9 sherry and Madeira varieties grown in California.

IMPORTATION OF ITALIAN GRAPES, E. W. HILGARD, PH. D. (pp. 4, 5).—"The importations of European grapes into California have thus far included but a few of the varieties grown in Italy; France, Germany, and to some extent Spain, being the countries most largely represented in our vineyards." There are, however, large portions of the State where more Southern varieties of grapes would naturally produce better results. Investigations by the station, which are to be published in detail, have indicated that Italian varieties of grapes might profitably be introduced. With a view to experiments in this line the station has imported "cuttings of 48 varieties of wine and table grapes from the collection of Count Giuseppe Rovasenda, the distinguished ampelographer of Italy, residing at Turin, with whom correspondence has been carried on for some time past by Assistant Paparelli. We are thus placed in possession of an authentically named collection, which will be partly rooted, and partly grafted for more rapid propagation and future distribution."

IMPORTATION OF OLIVES, E. W. HILGARD, PH. D. (pp. 5, 6).—Brief descriptive notes on 8 varieties recently "imported from the highly reputed nursery of R. Pecori of Florence, under the auspices of Professor E. Bechi, the director of the agricultural station at Florence. * * * These trees are now growing finely on the grounds of the station at Berkeley and will be propagated as rapidly as possible for distribution to the substations, and thereafter to olive culturists at various points within the State."

California Station, Bulletin No. 92, March 28, 1891 (pp. 4).

NOTES ON CALIFORNIA OLIVES, L. PAPARELLI.—An account of observations and experiments recently made by the author on a number of varieties of olives grown in California. The article includes tabulated and descriptive notes on the time of ripening, productiveness,

date of picking, proportion of pits and flesh in fruit, percentages of oil in pits and flesh, and the quality of the oil. The tests made indicated that the method of "iodine absorption" for determining the purity of olive oils is not altogether satisfactory. A simple method for detecting the presence of cotton-seed oil, devised by Professor E. Bechi, director of the experiment station at Florence, Italy, is described. Among the varieties of olives examined by the author the Manzanillo seems to be the best for pickling and the Nevadillo for oil.

Colorado Station, Bulletin No. 14, January, 1891 (pp. 15).

SUGAR-BEETS, D. O'BRINE, D. SC.—An account of a visit to the beet-sugar factory at Grand Island, Nebraska, and tabulated results of analyses by the station of sugar-beets grown in Colorado. The sugar-beets raised by the station in 1890 averaged over 15 per cent of sugar, and the yield per acre was over 26 tons.

Connecticut State Station, Bulletin No. 106, March, 1891 (pp. 14).

THE BABCOCK METHOD OF DETERMINING FAT IN MILK AND CREAM (pp. 2–9).—Details are given of this method, which was described in Bulletin No. 24 of the Wisconsin Station (See Experiment Station Record, Vol. II, p. 256). Regarding the accuracy of the method the following observations were made at the Connecticut Station:

In 17 cases the standard method used in chemical laboratories gave a lower result than the Babcock method; in 15 cases, a higher result. In 6 cases the difference exceeded 0.10 per cent and in 18 cases it was 0.05 or less. The average difference between the quantity of fat shown by this method and that shown by the standard method was less than 0.01 per cent in 32 comparative tests; that is, on the average, where 100 pounds of butter fat were actually present, the Babcock test showed 99.99 pounds. The greatest difference in any single case was 0.18 per cent or about 3 ounces of fat in 100 pounds. In the majority of cases the discrepancy was four fifths of an ounce or less in 100 pounds of fat.

Since October, 1890, fat determinations have been made in 206 samples of milk brought to creameries by individual patrons. "The milk from the individual dairies was of varied quality. The milk of one herd contained 5.25 per cent of fat, that of another 3.28 per cent of fat, and while the percentage varied somewhat from day to day, yet the milk of certain herds was uniformly rich in fat while that of other herds was as uniformly poor." Assuming that both patrons furnished the same quantity of milk (1,500 pounds per week), that the price paid was $1.10 per hundred pounds, and crediting nothing to the skim-milk, as the quantity would be the same in both cases—

A, the patron who produces the richer milk, who has the better cows or who feeds more rationally, gets 22 cents a pound for butter fat; and B, the patron whose milk is the poorer, whose herd is poor or feeding injudicious, gets 31.4 cents a pound. This is a premium of 10 cents per pound of fat on thin milk, or poor stock and feeding, or on judicious watering of the milk. * * *

Now suppose this creamery changes its policy and offers, as before, $1.10 per hundred for "standard" milk containing 4 per cent of fat, but allows 2.75 cents per hundred additional for every "unit" or tenth of a per cent of fat more than four in the milk, and deducts 2.75 cents per hundred for every "unit" or tenth per cent under four. Under this arrangement A would receive $20.63 for his 1,500 pounds of milk, furnishing 75 pounds of butter fat. He receives, therefore, 27.5 cents per pound for the butter fat.

B would receive $14.43 for 52.5 pounds of butter fat, and for each pound 27.5 cents, the same that his neighbors receive for a like amount of butter fat. * * * These particular prices are for nothing more than to illustrate the point. The actual rate to be paid must depend of course on what the creamery can produce butter for and sell it for.

It is believed that the practice of paying for butter fat rather than for milk—which is rendered practicable by the methods referred to in this bulletin—will gradually reduce the cost of producing butter, will increase the profits of the honest and intelligent patrons, and offer more inducement than there now is for improving herds and feeding liberally, and for quality rather than quantity of milk.

Experiments at the station, as well as elsewhere, have shown that the Babcock method can be applied to the determination of fat in cream. This matter will be discussed in a future bulletin of the station.

BUTTER ANALYSES (pp. 9–11).—Tabulated analyses are given of 11 samples of butter from private dairies, and 6 samples of creamery butter, exhibited at the meeting of the Connecticut Dairymen's Association, at Hartford, January 20–22, 1891. The samples of butter were graded on the following scale of 100 points: flavor 50, grain 25, color 15, salt 5, and package 5.

"The private dairy butters which received the lowest grading for flavor, grain, and salt, were ones which had the very abnormally high per cents of salt (6.78 and 7.83). It is somewhat surprising that the one containing 5.23 per cent of salt should have scored as high as it did. The creamery butter as a rule carried 3 per cent more of actual butter fat than the private creamery butter."

FERTILIZERS (pp. 11–14).—Remarks on the requirements of the fertilizer law of Connecticut, the gratuitous analysis of fertilizers, and the trade values of fertilizing ingredients adopted for 1891 by the Connecticut, Massachusetts, and New Jersey Stations.

"These trade values are the average prices at which in the 6 months preceding March the respective ingredients could be bought at retail for cash in our large markets, Boston, New York, and Philadelphia, in the raw materials which are the regular source of supply."

As compared with the valuations for 1890, that of nitrogen in ammoniates is advanced from 17 to 18½ cents per pound; that of nitrogen in nitrates remains the same (14½ cents); and that of organic nitrogen, except in the form of cotton-seed meal and castor pomace, is 1 to 1½ cents per pound less. Soluble and reverted phosphoric acid remain the same as in 1890, but a reduction of one half to 1 cent per pound is made in the medium and coarser forms of bone and tankage. Potash as sulphate is reduced from 6 (1890) to 5½ cents, but as muriate is unchanged.

Illinois Station, Bulletin No. 15, February, 1891 (pp. 28).

THE FRUIT BARK BEETLE, S. A. FORBES, PH. D. (pp. 469–478).—The fruit bark beetle (*Scolytus rugulosus*, Ratz.) was first observed in Illinois, June 15, 1888, by Mr. John Marten. Since then it has been found to be quite widely distributed in the State. This article contains notes on the history of the insect in Illinois and elsewhere in the United States and in Europe, its injuries to vegetation, description, life history, and remedies. There is need of further information regarding the life history of this insect, on which to base experiments on its repression, and investigations are in progress under direction of the author.

EXPERIMENTS WITH GRASS SEEDS, AND WITH GRASSES AND CLOVERS, G. E. MORROW, M. A., AND T. F. HUNT, B. S. (pp. 478–489).—In this article experiments are reported in the following lines: tests of the vitality of grass seeds, comparison of varieties of grasses and clovers, tests of varieties and mixtures of grasses and clovers, and the effect of fertilizers on Kentucky blue-grass pasture.

Experiment No. 93.—Grass seeds, test of vitality (pp. 478–482).—In the summer of 1889 samples of Kentucky blue-grass, redtop, and timothy seed, obtained from 17 prominent seedsmen of this country, and one sample of Kentucky blue grass seed gathered on the station grounds were treated in a Geneva apparatus. The results, as tabulated, show that "less than 2 per cent of the blue-grass, 25 per cent of the redtop, and a little more than 76 per cent of the timothy sprouted." Tests of other samples of the Kentucky blue-grass seed were made in boxes in the open air and in a greenhouse. The tabulated results show that "48 per cent of the samples gathered upon the station grounds grew in soil in the open air and 57 per cent in soil in the greenhouse. Of the 18 samples of seed obtained from 17 seedsmen less than 21 per cent sprouted in the open air and a little more than 12 per cent in the greenhouse. The greenhouse proved unsatisfactory as a place to test the seeds. The heat and moisture sprouted the seeds well enough, doubtless, but caused them also, in greenhouse parlance, 'to damp off.'"

The seedsmen having stated that it was their practice "to cut or strip Kentucky blue-grass for seed when it was still quite green," experiments were made at the station to test the effect of this practice on the vitality of the seed. The results, as tabulated, show that 72 per cent of the seeds germinated in the samples gathered when green, and 80 per cent in the samples gathered when ripe.

Experiment No. 16.—Grasses and clovers, comparison of varieties (pp. 482–485).—Brief notes on plat experiments with redtop (*Agrostis vulgaris*), orchard grass (*Dactylis glomerata*), meadow fescue (*Festuca pratensis*), tall fescue (*Festuca elatior*), sheep's fescue (*Festuca ovina*), hard fescue (*Festuca duriuscula*), tall meadow oat grass (*Arrhenatherum avenaceum*), Italian rye grass (*Lolium italicum*), perennial rye grass (*Lolium perenne*), rough-stalked meadow grass (*Poa trivialis*), wood meadow grass (*Poa

nemoralis), sweet vernal grass (*Anthoxanthum odoratum*), meadow fox-tail (*Alopecurus pratensis*), mammoth red clover (*Trifolium medium*) alfalfa (*Medicago sativa*), alsike clover (*Trifolium hybridum*), and crimson, clover (*Trifolium incarnatum*). The best results thus far have been with meadow fescue, tall fescue, tall meadow oat grass, and mammoth red clover.

Experiment No. 19.—*Grasses and clovers, test of varieties and mixtures* (pp. 485–487).—Medium and alsike clover, orchard grass, and timothy singly, timothy with mammoth, medium, or alsike clover, and orchard grass with medium or alsike clover were sown in 1888 on 9 two-acre plats. The time of cutting and yields of hay in 1889 and 1890 are tabulated for each plat.

The time of cutting, as well as the field notes, indicate that alsike clover ripens earlier than medium red clover; that medium red clover and orchard grass ripen about the same time; that timothy ripens from 3 to 5 weeks later than medium red clover and about the same time as mammoth red clover. * * *

The largest yield of hay, 2.7 tons per acre, was from timothy and mammoth clover sown together, which during the 2 years gave a larger yield at two cuttings than timothy and medium red clover at three cuttings.

Timothy gave the largest yield, 2.2 tons per acre, of any single plant, giving a little more at two cuttings than did medium red clover at three.

Orchard grass gave a little larger yield than alsike clover, but both yielded very much less either when sown alone or sown together than did timothy or red clover. They yielded less when sown together than when sown alone. Orchard grass and red clover, and timothy and alsike clover gave poorer yields than timothy and red clover.

Experiment No. 86.—*Effect of fertilizers on Kentucky blue-grass* (pp. 487–489).—Superphosphate, muriate of potash, and nitrate of soda, singly and all three together, horse manure, cattle tankage, and gypsum were applied in 1889 and 1890 "to a Kentucky blue-grass pasture of at least 15 years' standing." The tabulated results, as compared with those on three plats receiving no manure, indicate that the greatest increase of yield was caused by horse manure.

Neither potash salts nor nitrate of soda when used singly at the rate of 200 pounds per acre materially increased the yield. Nitrate of soda always gave the grass a greener color. Gypsum, at the rate of 500 pounds per acre, seemed to have no effect. The use of superphosphate, muriate of potash, and nitrate of soda together increased the yield 67 per cent. Estimated as heretofore, the increase would be worth $2.68. The cost of the application was about $16 per acre.

EXPERIMENTS WITH FUNGICIDES ON THE APPLE, POTATO, AND GRAPE, T. J. BURRILL, PH. D., AND G. W. MCCLUER, B. S. (pp. 489–496).—Notes on spraying experiments with eau celeste, Bordeaux mixture, and carbonate of copper for apple scab, potato blight, and black rot of grapes.

Indiana Station, Second and Third Annual Reports, 1889 and 1890 (pp. 27 and 18).

The report for 1889 is by the director of the station, H. E. Stockbridge, PH. D., and includes brief statements regarding the staff, work, and publications of the station and a financial report for the fiscal year ending June 30, 1889.

The report for 1890 is by the vice-director of the station, C. S. Plumb, B. S., and includes an account of additions to the buildings and equipment of the station, a list of the bulletins issued during the year, a brief synopsis of the work in the various departments of the station as reported by the respective officers, and a financial report for the fiscal year ending June 30, 1890.

Indiana Station, Bulletin No. 33, October, 1890 (pp. 34).

An account of the following article was omitted from the abstract of this bulletin in Experiment Station Record, Vol. II, p. 327:

ABSORPTIVE POWER OF SOILS, H. A. HUSTON, M. A., AND A. GOSS, B. S. (pp. 46–54).

The importance of the absorptive power of the soil can hardly be overestimated. By means of this power those mineral ingredients of plant food of which most soils contain but little, are held in a form too insoluble to allow of rapid loss by drainage and still soluble enough to answer the needs of vegetation, provided the store is large enough. The only important plant food liable to be deficient in the soil which does not come under the influence of absorption is nitrogen in the form of salts of nitric acid, and nature has made a wise provision for this element by binding it in the form of organic bodies, which nitrify but slowly, and by supplying each year a small quantity from the atmosphere.

By means of the absorptive power of soils, the farmer, if he puts on an excess of potash or phosphoric acid as a fertilizer, does not lose it, but is able to reap the benefits from it in the next year's crop. If it were not for this power, the best method for applying fertilizers would be a much more complicated problem than it is at present, as it would be necessary to apply them at just the proper season, and in nicely regulated amount to insure against loss.

A brief discussion is given of the causes of absorption, a summary of what has been learned regarding soil absorption, and an account of experiments made by the authors on the soil of the station farm.

The soil experimented upon was "a dark clay loam containing also considerable sand." Samples of the mixed soil to the depth of 9 inches were treated with water, and approximately tenth-normal solutions of ammonium sulphate, potassium chloride, potassium sulphate, sodium nitrate, and sodium phosphate, in the following manner:

"One hundred grams of the sifted air-dried soil were placed in rubber-stopped bottles, and treated with 250 c. c. of the solution to be tested. The digestion was continued for 48 hours, in each case the bottles being thoroughly shaken at the end of 24 hours. At the end

of the treatment the solutions were filtered off and the salts determined in aliquot portions."

The tests with water showed that phosphoric acid, ammonia, and potash were either absent or present in too small quantities to affect the results. The analyses are given of the various solutions used before and after their action on the samples of soil, together with the percentage of salt removed from each solution by 100 grams of soil. The latter were as follows: from sodium phosphate solution, 29.6 per cent; sodium nitrate, none; potassium chloride, 26.5 per cent; potassium sulphate, 28 per cent; ammonium sulphate, 27.5 per cent.

"It will also be noticed that the percentages of absorption are not very different, and especially is this true of the potash and ammonia salts, the phosphoric acid being somewhat higher. Whether this fact is merely an accidental occurrence or is due to the law of combination by equivalents" the authors are not prepared to say. Calculations are made which indicate that the absorptive power of the soil (9 inches in depth) would enable it to take up 45 times as much phosphoric acid and 27 times as much potash as is likely to be applied in a fertilizer, and 32 times as much ammonia as would be furnished by a dressing of one fourth ton of ammonium sulphate per acre. "Hence we may conclude that liberal dressings of phosphoric acid and potash may be used without danger of serious loss; that the phosphoric acid and potash not used by any crop will be retained by the soil and be available for following crops."

In view of the fact that ammonia salts are likely to change to nitrates in the soil "it is not always advisable to use ammonia salts in any great excess, since the nitrates formed from this are liable to be lost."

Indiana Station, Bulletin No. 34, February, 1891 (pp. 28).

SUGAR-BEETS, H. A. HUSTON, M. A. (pp. 55-65).—Brief suggestions regarding the culture of sugar-beets, and notes and tabulated data on experiments in several localities in Indiana, including the results of analyses of beets from Indiana by the Division of Chemistry of this Department. The tests thus far made in Indiana are sufficiently promising to warrant further experiments in this line, especially in the northern part of the State.

FIELD EXPERIMENTS WITH FERTILIZERS ON BARLEY AND OATS, W. C. LATTA, M. S. (pp. 66-71).—"The growing season of 1890 was, as a whole, unfavorable to spring-grown cereals. * * * It is probable, therefore, that the full effect of the fertilizers was not realized upon either crop."

Barley.—This experiment was made on 7 twentieth-acre plats. The fertilizers used were a mixture at the rate per acre of 140 pounds dissolved bone-black, 62.5 pounds muriate of potash, and 235 pounds sulphate of ammonia, and one containing two thirds these amounts; 1,000

pounds fresh horse manure, and two thirds that amount (667 pounds), each applied on one plat. The three remaining plats received no manure.

The yields of barley and straw, the increased yields on the fertilized over the unfertilized plats, and the yield of corn on the same plats in 1889 are given. The differences in yield of barley on the three unfertilized plats (8.2, 10.2, and 16.4 bushels per acre) are so much more prominent than any following the application of fertilizers (21.5, 18.3, 21.5, and 21.9 bushels), that no reliable conclusions can be drawn, further than that the fertilizers increased the yield of both grain and straw.

Oats.—Two series of experiments were made with oats. The first was on 17 twentieth-acre plats. Dissolved bone-black at the rate per acre of 140 pounds, sulphate of ammonia 290 pounds, and muriate of potash 85 pounds were each applied singly, two by two, and all three together; and fresh horse manure 1,202 pounds, fresh cattle manure 2,000 pounds, gypsum, slacked lime, and salt 30 pounds each, were each applied alone on one plat. Five plats remained unmanured. "The special object of the fertilization of this series is to compare the effects of complete and partial manures. The amount of fertilizer is sufficient in every case to meet the demands for the particular element or elements supplied of a 50 bushel yield of oats per acre."

Tabulated results are given showing the yield of corn on the same plats in 1889, yield of oats and straw in 1890, and increased yield over the unfertilized plats.

The table shows (1) fairly uniform yields of corn and even greater uniformity in yield of oats on the unfertilized plats; (2) a greater increase from a complete commercial manure than from stable and partial manure; (3) that fertilizer ingredients in pairs generally produced better results then when used singly; (4) that of the substances used singly, salt produced the greatest increase of oats, while bone-black ranked second, and muriate of potash third; (5) that gypsum and lime were practically without effect on the yield of grain, while sulphate of ammonia, alone and with bone-black, reduced the grain yield; (6) that the stable manures caused a slight increase and sulphate of ammonia a marked increase in the proportion of straw; (7) that the complete commercial fertilizer and also bone-black, muriate of potash, gypsum, and salt considerably reduced the proportion of the straw.

The second series of experiments with oats was made on 7 plats, fertilized on essentially the same plan as in the above experiment, with barley. Four plats received sufficient amounts of horse manure and "complete" commercial fertilizer, respectively, to furnish a crop of 50 and of 33⅓ bushels of oats per acre. The data given are the same as for the other experiments.

"It will be observed (1) that the unfertilized plats show a fairly uniform degree of natural fertility; (2) that all the fertilized plats show fair though not large gains; (3) that the full application of [commercial] fertilizer produced little more grain and less straw than the two thirds application; (4) that the full manuring [with horse manure] produced

considerably more grain and very much more straw than the two thirds application."

EXPERIMENTS WITH VEGETABLES, J. TROOP, M. S. (pp. 72-80).—Tabulated data for 83 varieties of potatoes, 50 of sweet-corn, and 30 of peas. Brief accounts are given of experiments in planting whole potatoes and cuttings of different sizes, and in trench *vs.* hill culture. The whole tubers gave larger yields than the cuttings, and hill culture than trench culture. Tubers from which the sprouts had been removed gave larger yields than the sprouts alone, though the latter produced a more vigorous growth of tops. "Arsenite of ammonia" compared favorably with Paris green and London purple as an insecticide for the potato beetle. Previous experiments with potatoes, sweet-corn, and peas are reported in Bulletins Nos. 18 and 31 of the station (See Experiment Station Record, Vol. I, p. 35, and Vol. II, p. 50).

Early Albino, Early King, Early Oxford, and Early Sunrise potatoes are among the best early varieties for this region.

Of late varieties of potatoes, Badger State, Breeze, California Rose, Dakota Red, Gold Flake, La Fayette, New Giant, No. 2000, White Elephant, and White Rose are especially recommended for this locality. * * *

The following 15 varieties of sweet-corn will give probable satisfaction if given proper care: Black Mexican, Concord, Crosby, Eight-Rowed, Genesee, Henderson, Hickox, Honey, Landreth (early), Livingston's Evergreen, Marblehead, Ne Plus Ultra Nonpareil, Orange, and Stowell.

The following peas are desirable for family use, to be planted in succession: Advancer, O'Rourke, Kentish Invicta, Abundance, Dwarf Sugar, Telephone, Stratagem, Golden Vine, and Champion.

Indiana Station, Bulletin No. 35, March, 1891 (pp. 29).

LOOSE SMUT OF OATS, J. C. ARTHUR, D. SC. (pp. 81-107, illustrated).—This contains notes on the occurrence of the loose smut of oats (*Ustilago avenæ*) in Indiana and elsewhere, and accounts of experiments in the treatment of smut with hot water and sulphate of copper (blue vitriol). Details are given in a number of tables. Reference is made to investigations in this line reported in Bulletin No. 28 of the station, and in Bulletin No. 8 and in the Annual Report of the Kansas Station for 1889 (See Experiment Station Record, Vol. I, pp. 207 and 216, and Vol. II, p. 342). Bulletin No. 15 of the Kansas Station (See Experiment Station Record, Vol. II, p. 638) also contains accounts of similar investigations. The experience of the author is in favor of the hot-water method of treatment, and he advises that the seed be immersed for 5 minutes in water at 140° to 145° Fah., allowing "the temperature to drop as it will, so long as it does not fall below 130°. If, however, it should by accident drop below 130°, the time must be extended over 5 minutes."

In the experiments at the station in 1890, the seeds treated with hot water germinated more quickly and grew more vigorously than those

treated with sulphate of copper or left untreated. It was also found that the seeds treated with hot water germinated more rapidly than the untreated seeds "whatever the length of time that had intervened between the treatment and the germinating test, even up to nine months." In experiments with sulphate of copper it was observed that the plumules started out earlier than the rootlets. This was due to the fact that "the primary roots were killed before starting and the secondary ones, which took their places, were consequently late in appearing. This action of the copper sulphate in killing the primary roots and retarding germination has been known for some time, although but few observations have been recorded."

Kansas Station, Bulletin No. 15, December, 1890 (pp. 43).

ADDITIONAL EXPERIMENTS AND OBSERVATIONS ON OAT SMUT, MADE IN 1890, W. A. KELLERMAN, PH. D., AND W. T. SWINGLE, B. S. (pp. 93–133, illustrated).—Previous accounts of statistics and experiments on oat smut (*Ustilago avenæ*) may be found in Bulletin No. 8 and the Annual Report of the station for 1889 (See Experiment Station Record, Vol. I, p. 216, and Vol. II, p. 342). A similar report on experiments with fungicides for stinking smut of wheat (*Tilletia fœtens* and *T. tritici*) was published in Bulletin No. 12 of the station (See Experiment Station Record, Vol. II, p. 220). In the present bulletin are observations as to the amount of oat smut, an account of experiments in preventing the smut in 1890, brief statements regarding hidden smut, a discussion of the increase in yield caused by the Jensen hot-water treatment of the seed, and full directions for treating the seed to prevent the smut.

Amount of smut (pp. 94–100).—Tabulated data are given for counts of the amount of smut in fields at Manhattan and elsewhere in Kansas, and in plats on the station farm, where "two hundred single plants of each of 80 varieties of oats were planted, each plant having a space of 64 square inches." The twenty field counts reported show an average of 6.46 per cent of smut in 1890, "an amount considerably smaller than that obtained for 1888 and 1889." The amount of smut in the plats varied very greatly, ranging from 0 to 50 per cent. Seventeen varieties had over 11 per cent of smut. Counts of the smutted heads were also made on 15 plats planted with "light, common, and heavy seed," as explained in Bulletin No. 13 of the station (See Experiment Station Record, Vol. II, p. 223). The results, as tabulated, show that "the common seed gave the largest per cent (13.25) of smut, the light seed the least (9.23), while the heavy seed gave a percentage about midway between the other two (10.78).

Hidden smut (pp. 100–102).—In the case of a few varieties of oats it was found that "many heads having nearly or quite the normal appearance were nevertheless smutted." Heads of oats affected in this way are illustrated in a plate.

The smut could be positively detected only by cutting open the husks. In this hidden smut, as it may be called, the outer glumes are of the usual size and shape and quite sound. Usually but one grain is developed; its hulls are sound and tightly closed; the grain is smaller than usual. A rudimentary grain is usually produced on its furrowed (inner) side, and this from the exterior usually shows the smut. Upon forcing open the husks the larger grain is found to be more or less completely destroyed by smut. * * * By careful inspection marks or characters, though rather obscure, may yet be detected by which heads attacked with the hidden smut may be recognized even without dissection: (1) They are usually greener in color and lack the yellowish tinge of ripening heads that are sound. (2) The tips of the outer glumes are usually bleached, while the bases are a deep green. (3) Ordinarily some of the grains, especially the lower ones, are stunted and very evidently smaller, and especially narrower than healthy ones.

Microscopic examination showed that the spores in the hidden smut from Canadian Triumph, Welcome, and White Swede are all smooth, and apparently belong to the form named by us var. *lævis*. The spores were sometimes found to be partially immature or poorly developed, often also monstrous in form and size. But it should be remarked that the var. *lævis* is not always hidden smut; yet it never seemed to occur in the loosest form of smut.

Experiments in preventing smut in oats (pp. 102–120).—Brief accounts are given of successful experiments on three farms in the use of the Jensen hot-water treatment of the seed of oats to prevent smut. Descriptive notes and tabulated data are also given for experiments by the station in 1890 in treating the seed of oats with various fungicides before planting on 156 plats, 155 alternate plats being planted with untreated seed. The fungicides included hot water at different temperatures (120.2° to 143.6° Fah.) and for different periods (3 to 20 minutes), the seed having in some cases been previously soaked in water for from 1 to 8 hours; potassium sulphide, sodium hyposulphite, copper sulphate, copper nitrate, sodium bicarbonate, verdigris, mercuric chloride, salicylic acid, potassium bichromate, carbon bisulphide vapor, ammonium hydrate vapor, chloroform vapor, ether vapor, castile soap solution, and cistern water (24 hours). The treatments with hot water gave the best results.

The only other treatment which gave results at all comparable with those obtained by using hot water was that with one half to three fourths per cent solutions of potassium sulphide in which the seed was allowed to stand 24 hours. When fresh solutions were used a one fourth per cent solution did not prevent all the smut, a three fourths per cent solution destroyed all the smut but injured the stand, while a one half per cent solution destroyed all the smut without injuring the stand. * * *

Of the hot-water treatments seven plats were planted with seed that was allowed to cool gradually after immersion in hot water. In every instance corresponding plats were planted with grain treated in exactly the same manner, but cooled after immersion by being plunged into cold water. The cooled and uncooled seed was planted in adjacent plats separated by a single untreated plat.

In every case the plats treated with gradually cooled seed gave a less per cent of smut than those planted with seed cooled as usual. * * *

Such a result might very naturally be expected, since the real effect of not quickly cooling the seed is simply to prolong the action of the hot water. It is very evident that such action would persist longest in the interior of a mass of grain, and thus might overtreat (and injure) some of the grain while other parts were not yet sufficiently treated. The use of cold water insures the treatment of each grain in nearly the same degree. It may yet be found possible and desirable to omit cooling the seed,

especially if it be spread out in a uniform layer immediately upon being taken from the water.

In a number of plats the seed treated in hot water had been previously soaked several hours in cold water. The effects of this soaking were as expected; the smut was fully prevented by a shorter immersion or by treating at a lower temperature than is necessary when dry seed is used. Further experiments will be necessary before this form of the hot-water treatment can be recommended. Without doubt previously soaking the seed will greatly shorten the time necessary for the treatment—perhaps to 5 minutes.

Treating the seed for a short time in water of a higher temperature was also found to be effective in destroying the smut. It is likely, however, that in treating dry seed at high temperatures there will be danger of leaving a few seeds unwetted, especially when large quantities are treated at once. There is also danger that the center of the mass of seed will not have time to become heated to the temperature of the water.

Because of the uncertainty of these modifications of the hot-water treatment, we recommend, as before, the immersion of dry seed 15 minutes at 132.5° Fah. * * *

A comparison of the results here published with those for wheat given in Bulletin 12, shows that oats are injured by chemical solutions much more easily than wheat. The effect of hot water is apparently about the same on both.

Increased yield on treated plats (pp. 120–127).—The comparative yields on forty-seven of the best treated and untreated plats are shown graphically in diagrams. It was found that very many of the treated plats gave a yield greatly exceeding that which would result from simply replacing the smutted heads in the untreated plats with sound ones.

The direct damage in the untreated plats, resulting from part of the heads being smutted, averaged 11.34 per cent. The treated plats gave an average yield 45.27 per cent greater than that of the untreated plats, or nearly four times as great an increase as would be obtained by merely replacing the smutted heads in the untreated plats with sound ones.

This is in accord with the results of experiments previously recorded by the authors. It has been suggested by the authors and by Jensen that the increased yield is due to the fact that the hot-water treatment causes the seed to germinate better. This, however, "seems entirely inadequate to account for the extra increase observed in our experiments, both in 1889 and 1890." Jensen has recently suggested that many plants are weakened by smut which does not reach the head, but smut of this character has not yet been observed.

Directions for treating the seed (pp. 128–130).—Full directions are given for the treatment of oat seed with hot water and with potassium sulphide. With regard to the former treatment the following suggestions are made:

Provide two large vessels, as two kettles over a fire, or boilers on a cook stove; the first containing warm water (say 110° to 130°), the second containing scalding water (132.5°).

The first is for the purpose of warming the seed preparatory to dipping it into the second. Unless this precaution is taken, it will be difficult to keep the water in the second vessel at a proper temperature.

The seed which is to be treated must be placed, a half bushel or more at a time, in a closed vessel that will allow free entrance and exit of water on all sides. For this purpose a bushel basket made of heavy wire could be used, within which spread wire

netting, say 12 meshes to the inch; or an iron frame could be made at a trifling cost, over which the wire netting could be stretched. This would allow the water to pass freely, and yet prevent the passage of the seed. A sack made of loosely woven material (as gunny sack) could perhaps be used instead of the wire basket. A perforated tin vessel might be preferable to any of the above.

Now dip the basket of seed in the first vessel; after a moment lift it, and when the water has for the most part escaped, plunge it into the water again, repeating the operation several times. The object of the lifting and plunging, to which might be added also a rotary motion, is to bring every grain into contact with the hot water. Less than a minute is required for this preparatory treatment, after which plunge the basket of seed into the second vessel. * * *

The important precautions to be taken are as follows: (1) Maintain the proper temperature of the water (132.5° Fah.), in no case allowing it to rise higher than 135° or to fall below 130°. This will not be difficult to do if a reliable thermometer is used and hot or cold water be dipped into the vessel as the falling or rising temperature demands. Immersion 15 minutes will not then injure the seed. (2) See that the volume of scalding water is much greater (at least six or eight times) than that of the seed treated at any one time. (3) Never fill the basket or sack containing the seed entirely full, but always leave room for the grain to move about freely. (4) Leave the seed in the second vessel of water 15 minutes.

Summary of important points (p. 130).

(1) Oat smut is a disease caused by the attack of a parasitic fungus, called *Ustilago avenæ.*

(2) The disease is spread by the spores which become inclosed in the hulls of the grain, or perhaps rarely by spores in the soil.

(3) In case of a few varieties there was found "hidden" smut, that is, smut which was concealed by the normal outer glumes or chaff, yet each grain was completely destroyed.

(4) The amount of smut in 1890, as based on several careful counts, was between 6 and 7 per cent. The consequent loss estimated for the entire State is $1,743,827.88.

(5) The extent of damage to the crop is not limited to the amount of visible smut, since treated seed gives an increase in yield at least twice as great as would result from merely replacing the smutted heads by sound ones.

(6) In all ordinary cases the disease can be entirely prevented by treating the seed 15 minutes in water raised to a temperature of 132.5° Fah.

(7) The smut may also be prevented by immersing the seed 24 hours in a one half per cent solution of potassium sulphide. This statement, however, is based on a very few experiments of this year only.

(8) The other fungicides tested, when destroying all or nearly all the smut, greatly injure the stand.

(9) Seed from clean fields will produce a crop free from smut, but if the adjoining fields are smutty the oats will gradually become infected.

Kentucky Station, Bulletin No. 32, March, 1891 (pp. 20).

STRAWBERRIES AND VEGETABLES, C. L. CURTIS.—Brief descriptive notes and tabulated data for 43 varieties of strawberries, and notes on 20 varieties of peas, 8 of beans, 7 of lettuce, 11 of radishes, 9 of tomatoes, 5 of cabbages, 8 of sweet-corn, 4 of celery, 5 of water-melons, and 13 of musk-melons.

Louisiana Stations, Bulletin No. 8 (Second Series), (pp. 48).

ANNUAL REPORT OF THE NORTH LOUISIANA EXPERIMENT STATION, 1890, J. G. LEE, B. S. (pp. 166–214).

The station orchard (pp. 170–173).—A list of the varieties of orchard fruits growing at the station includes 10 of figs, 1 of filberts, 4 of almonds, 6 of quinces, 15 of apricots, 8 of nectarines, 3 of chestnuts, 10 of Japanese persimmons, 16 of plums, 34 of pears, 32 of peaches, 40 of apples, and 56 of grapes.

Live stock and poultry (pp. 173–175).—Brief notes on Red Jersey, Berkshire, Essex, White Chester, and Yorkshire pigs; Southdown and Shropshire sheep; Holstein and Jersey cattle; and twelve breeds of hens.

Grain and forage plants (pp. 175–178).—Brief notes on a fertilizer experiment with oats and barley, on 4 varieties of clover and 6 of grasses, and on alfalfa.

Rotation of crops (pp. 178, 179).—Experiments in rotation of crops have been begun on 3 plats. The rotation will include corn, oats, peas, and cotton. The effects of fertilizers as compared with no manure will also be tested. The results obtained in 1890 on these plats are briefly stated.

Field experiments with cotton (pp. 179–193).—These are a continuation of the experiments reported in Bulletin No. 27 of the Louisiana Stations (See Experiment Station Record, Vol. II, p. 148), and include investigations on the manurial requirements of cotton on the soil of the station farm, tests of varieties, and of different distances of planting.

Effects of fertilizers on cotton (pp. 179–185).—As in previous years, these were special nitrogen, phosphoric acid, and potash experiments. The questions propounded on the respective plats were, (1) Does this soil need nitrogen (or phosphoric acid or potash) to grow cotton successfully? (2) If so, in what form can it be best applied? (3) In what amounts per acre?

Special nitrogen experiments.—Nitrate of soda, "mixed minerals" (acid phosphate and kainit), sulphate of ammonia, dried blood, fish scrap, cotton-seed meal, cotton-seed, compost, and kainit were used singly and in various combinations and compared with no manure. The soil of the the plat used was quite uneven, but the tabulated results, as in previous experiments at this station, indicate that these particular soils need nitrogen very badly. But it is not so clear which is the best form to use. In 1890 nitrate of soda gave results slightly better than the others, but was closely followed by cotton-seed meal and dried blood. Twenty-four pounds of nitrogen per acre seems to be as much as can be profitably used on these poor soils.

Special phosphoric acid experiments.—Gypsum, dissolved bone-black, acid phosphate, bone meal, floats, and a basal mixture (cotton-seed meal and kainit) were used alone and in various combinations, and compared

with no manure. The tabulated results as in previous experiments here indicate that phosphoric acid in small quantities may be profitably applied to this soil.

Special potash experiments.—Cotton-seed meal and hull ashes, meal phosphate (cotton-seed meal and acid phosphate), kainit, and muriate and sulphate of potash were used alone and in various combinations, and compared with no manure. The tabulated results indicate that potash if used at all should be applied "in very small quantities and combined with other manures."

Proper depth for applying fertilizers for cotton (pp. 185–187).—As in 1889, the questions considered were: (1) At what depth are fertilizers most available for cotton? (2) Is it best to apply the fertilizing ingredients separately and at different depths? The results agreed with those of the previous year in indicating that a depth of 2 or 3 inches is the best one at which to apply "complete" fertilizers on this soil.

Tests of varieties of cotton (pp. 187–190).—Tabulated data are given for 37 varieties. "Jones's Improved gives the largest yield of seed cotton per acre, followed closely by Grayson's Early Prolific, Peterkin, Oats, Allen's Long Staple, Little Brannon, and Tennessee Silk. Peterkin gives the largest yield of lint per acre, followed by Jones's Improved, Little Brannon, Bancroft's Herloug, Grayson's Early Prolific, Texas Storm and Drought-Proof, John O. Morris's, Tennessee Gold Dust, etc. The best per cent of lint is from Deering Small Seed, Peterkin, W. B. Ethridge Small Seed, Texas Storm and Drought-Proof, etc."

Distance of planting (pp. 190, 191).—Tabulated data for nine plats on which cotton was planted in drill at different distances. As in 1889 the best results were with two stalks 16 inches and two stalks 12 inches.

Effect of more than one application of nitrogen for cotton (pp. 191–193).—Various fertilizers containing nitrogen were applied once, twice, or three times during the same season. The tabulated results, as in 1889, indicate that little effect was produced by the second and third applications.

Field experiments with corn (pp. 193–200).—As in 1889 these include experiments with fertilizers and tests of varieties. The former were similar to those with cotton above cited and the results in general pointed in the same directions as in the case of cotton. Tabulated data are given for 25 varieties of corn.

Experiments with forage plants, sorghum, sweet-potatoes, sugar-cane, etc. (pp. 200–213).—Brief accounts are given of tests of teosinte, pearl millet, Kaffir corn, millo maize, dhoura, Egyptian rice corn, German and Golden Wonder millet, Japanese buckwheat, beggar weed (*Desmodium molle*), white lupine, soja bean, cow-peas, pea-nuts, and several early varieties of sorghum.

A fertilizer experiment with sweet-potatoes is also briefly reported.

Analyses of samples of sugar-cane raised at the station for experiments in sugar making.—"From 1.5 acres of ground 2,400 pounds of sugar and

160 gallons of molasses were obtained. The sugar sold at 3 cents per pound, or $72; the molasses at 35 cents per gallon, or $56. Total for one and one half acres, $128, or per acre, $85.35." These results, which were obtained from poor land in the dry season, are considered very encouraging.

Louisiana Stations, Bulletin No. 9 (Second Series), (pp. 14).

SUGAR-CANE BORER AND ITS PARASITE, H. A. MORGAN, B. S. A. (pp. 215–228, illustrated).—A preliminary report on the sugar-cane borer (*Chilo saccharalis*), the investigation of which was begun at the Louisiana Stations in the fall of 1890. An account of the life history of the insect is given, with suggestions as to means for its repression. A soldier beetle (*Chauliognathus pennsylvanica*) was found to be a parasite on the sugar-cane borer.

Maine Station, Annual Report, 1889 (pp. 294).

INSPECTION OF FERTILIZERS, W. H. JORDAN, M. S., J. M. BARTLETT, M. S., AND L. H. MERRILL, B. S. (pp. 1–35).—Analyses are tabulated for 91 samples, representing 43 brands of commercial fertilizers collected within the State during 1889. Brief remarks are also made on the observance of the fertilizer law, sampling, methods of analysis, valuations, and home mixing.

Quality of nitrogenous materials in superphosphates.—"The nitrogen of dried blood, dried flesh, cotton-seed meal, and similar high grade nitrogenous materials is very largely dissolved by digestion in a pepsin solution, while that of horn, hoof, and leather is much less affected by this treatment."

The results of determinations of the solubility in pepsin solution of dried blood, cotton seed meal, ground bone, dried flesh, dried fish, fish scrap, tankage, wool waste, leather, horn and hoof meal, and of the organic nitrogen in 39 brands of commercial fertilizers analyzed by the station are tabulated.

The degree of solubility for cheap and inferior "ammoniates," such as horn, hoof, leather, and wool waste is seen to vary from 4.8 per cent to 37.8 per cent, while in the case of dried blood, cotton-seed meal, dried and ground flesh, dried fish, fish scrap, and ground bone the average percentages of the different trials range from 70.9 per cent to 97.3 per cent.

In the 39 brands tested the solubility of the organic nitrogenous material ranges from 21.3 per cent to 83.4 per cent. In 3 cases the percentages are below 40 per cent, in 3 between 40 and 50 per cent, in 4 between 50 and 60 per cent, and in 29 over 60 per cent. * * * A close grading of the quality of the nitrogenous matter of superphosphates does not seem to be possible by this method.

CATTLE FOODS (pp. 36–68).—The analyses are given of hay from timothy, wild oatgrass, redtop, blue-joint grass, and alsike clover raised in 1888, and for comparison the composition of these same grasses for several seasons past. Experiments to determine the

co-efficients of digestibility of the hay from these grasses were made with sheep in the ordinary manner, each kind of hay being fed to two sheep. The data obtained and the final results are tabulated.

Composition, digestibility, and yield of early cut and late-cut timothy.—A "very uniform field of timothy grass" was divided into 6 plats of about one fortieth of an acre each, the grass on every second plat being cut July 9 while in "early bloom," and that on the 3 remaining plats 15 days later. The composition, digestibility, and weights and loss in keeping of the hay from the two cuttings are tabulated. The results show "a small balance in favor of the early-cut hay."

Composition, yield, and digestibility of fodder from three varieties of corn.—This is a comparison of the Southern Ensilage corn, common field corn, and sweet-corn with reference to the yield of green fodder and dry matter, and the composition and digestibility of fodder and silage from the same. Data obtained in these determinations are tabulated. A number of unfavorable circumstances interfered with the success of the experiment.

"The digestion experiments with sheep did not show a superior digestibility for the silage over the dried fodder."

Composition and value of various commercial feeding stuffs.—This article, which is by J. M. Bartlett, M. S., includes the analyses of three samples each of white-wheat bran, red-wheat bran, wheat middlings, feed flour, corn meal, ground oats, cotton-seed meal, and linseed meal, and a statement of the calculated amounts of digestible fat, carbohydrates, and protein in each feeding stuff.

Comparative digestibility of wheat bran and wheat middlings.—The digestibility of white-wheat bran and wheat middlings was compared in an experiment with four sheep. The same basal ration, redtop hay, was fed to all, two sheep receiving wheat middlings, and the other two wheat bran, in addition to the hay. The digestibility of the redtop was determined separately. The analytical data, a statement of the weights of food and excretions, and the co-efficients of digestibility calculated from the results, are tabulated. The results indicate "a marked difference in the digestibility of middlings and roller bran. * * * Sheep digesting their food as they did in this experiment would get as much nutriment from 100 pounds of the middlings as from 123 pounds of bran."

Composition and digestibility of pea meal.—The composition of pea meal and its digestibility, as determined by feeding it in connection with corn silage of known digestibility to two sheep, are given with the accompanying data in tables.

FEEDING EXPERIMENTS, MISCELLANEOUS (pp. 69–84).

Value of the digestible matter of good hay as compared with that of corn silage for milk production and for growth.—To observe the effect on milk production, a portion of the hay in the ration of four cows which consisted of hay and a mixture of cotton-seed meal, bran, and corn meal,

was replaced by corn silage. About one third of the dry matter of the hay was substituted by silage; the grain ration remained unchanged. After 63 days the silage was dropped and the feeding resumed as before. The yield and composition of the milk and the digestible dry matter eaten are tabulated for each cow before, during, and after the silage feeding.

In this experiment the addition of silage to the ration resulted in a somewhat increased production of milk solids, which was not caused by an increase in the digestible food material eaten, but which must have been due either to the superior value of the nutrients of the silage over those of the hay or to the general physiological effect of feeding a greater variety of foods. 8.8 pounds of silage proved to be somewhat superior to 1.98 pounds of hay (mostly timothy), the quantity of digestible material being the same in the two cases.

An experiment was made with six young steers to test the value of silage for growing animals. In four periods of from 4 to 13 weeks' duration rations consisting of hay and mixed grains, and of hay, 20 pounds of silage, and some mixed grains were fed to all the steers alternately, each ration being fed during two periods. "The amount of hay fed was adapted to the appetite of the animal." The weights of hay and silage eaten and the gains made by each animal during each period are tabulated.

A pound of digestible matter from the corn silage produced somewhat more growth than a pound of digestible matter from timothy hay. The difference was small, however, amounting in the case of the last two periods, where the more accurate comparison is possible, to an increased growth of only 15 pounds of live weight for each ton of silage fed.

Early and late-cut timothy hay for growth.—This is a comparison of the feeding values of the timothy hay cut at blooming, and 15 days later, the relative digestibility of which was determined in a previous experiment with sheep, reported above. Six steers were fed from December 7 to January 3 on the late-cut hay, and from January 4 to February 13 on the early-cut hay. Three pounds of grain were fed per animal daily during both periods. The tabulated results indicate "no particular difference in the feeding value of these two lots of hay. This might be expected after finding that the hay had so little difference in composition and digestibility."

Feeding value of wheat middlings and wheat bran.—The feeding value of these two foods, pound for pound, was compared in an experiment with four pigs weighing about 200 pounds each. In period 1 (31 days) two of the pigs were fed skim-milk and wheat bran, and the two others like quantities of skim-milk and wheat middlings; in period 2 (41 days) the pigs were changed from bran to middlings and *vice versa*, the skim-milk being fed as before. The tabulated results indicate that in this experiment, "where very moderate rations of both middlings and bran were fed in connection with skim-milk, the growth from the middlings ration was over twice that from the bran ration, or in the ratio of 110 to 53."

FEEDING EXPERIMENTS WITH SWINE (pp. 85–105).—An account is given of experiments with twelve pigs, six lots of two each, which were variously fed as follows: Lots 1 and 2 received skim-milk and corn for 77 days, the skim-milk furnishing two thirds of the digestible matter to lot 1 and one third to lot 2, the total amount of digestible matter being the same in both lots; later lot 1 was changed to a ration of one third pea meal and two thirds corn meal, and lot 2 to water and corn meal. Lots 3 and 4 were fed alike on skim-milk and corn meal for 5 months; after this, for nearly 2 months, the skim-milk was replaced by pea meal in the case of lot 3, but the feeding was continued as before with lot 4. For 1 month lot 5 received a ration of skim-milk, corn meal, and potatoes, and lot 6, corn meal and potatoes; for nearly 4 months following, the skim-milk in the ration of lot 5 was replaced by pea meal, lot 6 receiving the same ration as at first; from March 26 until October both lots received skim-milk, bran, and corn meal; and following this a mixture of gluten meal and corn meal, and corn meal alone were fed to both lots in alternate periods.

Data, including statements of the food eaten, gains in live weight, and a general summary of all the results, are tabulated for each lot by periods. These receive a full discussion, closing with the following statement of the teachings of the experiments:

(1) In six feeding periods where the rations compared contained practically the same digestible material, 2,643 pounds of digestible food with a nutritive ratio ranging from 1:5.2 to 1:6.1 produced 890 pounds of growth, while 2,651 pounds of digestible food with a nutritive ratio varying from 1:8.9 to 1:9.4 produced 617 pounds of growth. It took nearly one half more food to produce a pound of growth with one set of rations than with the other.

(2) A ratio of 1:6 was compared with one of 1:3.6, and one of 1:5.6 was compared with another of 1:4.4, the resulting growth being practically the same.

(3) The advantage of a nitrogenous food in the ration seems to pertain to the fattening period as well as to the period of growth. A mixture of pea meal and corn meal or of gluten meal and corn meal proved to be much more efficient than corn meal alone in feeding animals already well grown and quite fat. The relative growth was from 20 to 60 per cent in favor of the ration containing one of the nitrogenous foods.

(4) Nitrogenous vegetable food seemed to exert a favorable influence upon the growth of swine, similar to that of skim-milk. Moreover the digestible matter of pea meal and of skim-milk proved to have a nutritive value practically equivalent.

(5) No marked effect was exerted upon growth by a wide variation in the amount of drink given to the two lots of animals.

(6) When skim-milk was substituted for part of a ration of corn meal without changing the amount of digestible dry matter fed, the efficiency of the ration was greatly increased. A still further substitution of milk for meal appeared not to materially increase the rate of growth. For instance, a ration one third of the nutrients of which were furnished by skim-milk in a single trial proved to be worth practically as much as a ration two thirds of the nutrients of which came from skim-milk.

TESTS OF SEVERAL BREEDS OF DAIRY COWS (pp. 106–134).—This is a report of the first year's trial of three breeds of cows, Ayrshire, Jersey, and Holstein, to test their relative value for dairy purposes.

Each of the three breeds was represented by two cows, although the complete record of only one Holstein is given. The pedigree and history of each cow are stated. The food given consisted of from 6 to 8 pounds per day of a mixture of two parts by weight of corn meal, and one part each of cotton-seed meal and wheat bran, as much hay as the animals would eat clean, 40 to 50 pounds of silage per day for 2 months in the spring, and pasturage during the summer months. While "an effort was made to adapt the food to their needs and appetite," a careful record was kept of the amount of the several articles of food (except pasturage) consumed by each cow, to allow of comparison. Full tabulated data are given on the food eaten by each cow during 1 year, cost of the same, yield of milk and milk products, composition of the whole milk, skim-milk, and buttermilk for each cow; cost of milk, milk solids, fat, cream, and butter, the prices of cream and butter corresponding to the milk of each cow at 1, 3, 4, and 5 cents per pound; ratio of the fat in cream to the other solids, waste of fat in the skim-milk and buttermilk, effect of food on the "churnability" of the fat, and the relation of the total fat in the milk to the butter obtained.

Although the results "can be more safely discussed at the end of another year's work," the following points may be cited:

The Holstein cow consumed the largest amount of food in the year and produced the largest amount of milk, milk solids, skim-milk, and buttermilk, and the second largest amount of butter, being exceeded in this by a Jersey cow producing 30 pounds more butter.

The order of richness of the milk was Jersey, Ayrshire, Holstein, the Jersey leading the other two breeds by a large difference. * * *

The milk of all the cows but one gradually increased in its percentage of solid matter as the period of lactation lengthened and the time of parturition approached.

The cream from different cows was unlike in butter value, that from the cows giving the poorest milk yielding less butter by about 25 per cent than the Jersey cream. Cream from the cows when in an advanced state of pregnancy had a diminished butter value.

The Jersey skim-milk proved to contain a slightly larger percentage of solids than the Ayrshire skim-milk, the Holstein skim-milk being much poorer than that of the other two breeds, the order being 10.7, 10.4, and 9.4 per cent. The skim-milk of the Ayrshires contained a large percentage of fat throughout the entire milking period, the separation of fat seeming to be less perfect than with the other two breeds. It was true of all the cows without respect to breed, that the percentage of fat in the skim-milk, or in other words the waste of fat, increased in a marked manner as the period of milking lengthened.

The buttermilk of each cow contained about the same percentage of total solids as her skim-milk, the quality following the same order as to breeds, viz., 10.44, 10.00, and 9.68 per cent. The buttermilk of Jerseys contained less than half as much fat as that of the other two breeds.

The percentage waste of fat in skim-milk and buttermilk varied from 4.1 to 26.8 per cent of the total fat, being least for the Jerseys and greatest for the Ayrshires. Over 90 per cent of this waste was in the skim-milk.

EXPERIMENTS WITH FERTILIZERS, W. BALENTINE, M. S. (pp. 135–144).—A continuation of previous experiments as to the availability of

phosphoric acid in ground phosphatic rock was taken part in by three farmers in 1888. The crude phosphates used were finely ground South Carolina rock and Caribbean Sea guano. Each trial was on 10 tenth-acre plats, fertilized as follows: finely ground South Carolina rock 1,000 pounds per acre, acid treated rock 500 pounds, and Caribbean Sea guano 725 pounds, were each used in combination with 150 pounds sulphate of ammonia and 100 pounds muriate of potash, on two plats; and to compare the effects of the phosphates the same mixture of sulphate of ammonia and muriate of potash, without phosphate, was used on two plats. Two plats received no fertilizer. Potatoes were grown in one experiment and corn in the other two. The tabulated yields of the crops in each experiment indicate—

(1) That the insoluble phosphoric acid in the finely ground South Carolina rock and the finely ground Caribbean Sea guano was able to furnish a considerable amount of phosphoric acid to the crops; (2) that the first crops were not able to avail themselves of as much phosphoric acid from the 272 pounds furnished by the 1,000 pounds of finely ground South Carolina rock and the 725 pounds of Caribbean Sea guano as from the 65 pounds soluble phosphoric acid furnished by the 500 pounds of acid South Carolina rock.

The results of pot experiments with oats, using the same fertilizing materials, "leave little room to doubt that a considerable amount of phosphoric acid was obtained by the plants from the crude phosphatic rock, amounting in the case of the Caribbean Sea guano to enough to produce more than an average crop of grain." Pot experiments with oats in which feldspar was substituted for muriate of potash, indicated that the potash in the feldspar was available to the crop.

The phosphates used in the pot experiments were of the same kind and composition as those used in the field experiments.

EXPERIMENTS IN GROWING MIXED GRAIN, W. BALENTINE, M. S. (p. 144).—Mixtures of peas and oats and of peas and barley were grown on two plats and compared with oats alone on another plat. The oats were attacked with rust, and the experiment was thus rendered inconclusive.

TESTS OF VARIETIES OF BARLEY, OATS, PEAS, AND POTATOES, W. BALENTINE, M. S. (pp. 145–147).—Tabulated notes on 2 varieties of barley, 5 of oats, 6 of peas, and 107 of potatoes.

REPORT OF BOTANIST AND ENTOMOLOGIST, F. L. HARVEY, M. S. (pp. 148–256).—Besides the work recorded in this report, the botanist and entomologist of the station during 1889 made studies on the codling moth, white-marked tussock moth, fall web-worm, and a scale insect affecting elm trees in Maine; collected herbarium specimens of grasses and other economic plants, and seeds of weeds and other plants; examined fungi, weeds, grasses, etc., sent to the station for determination; and read papers on "Fungi injurious to fruits," before the Maine State Pomological Society (to appear in its Annual Report), and on "The apple maggot," before the Pomological Society at Norway, Maine.

Germination experiments (pp. 149–160).—These were a continuation of those recorded in the Annual Report of the station for 1888, and were undertaken "to test commission seeds offered for sale in Maine, that were not examined in 1888; and to investigate a complaint from Aroostook County that dealers in that section were selling poor seeds." The tests included seeds of vegetables and clover put up by various seedsmen and offered for sale on commission in Maine. The results are stated in tables.

"Our tests show that the seeds of some dealers, wherever taken in the State, have a high germinating power, while the seeds of others are invariably poor. Most commission merchants offer for sale the seeds of several growers, and it is the object of germination tests to show which growers put up the best seeds. There is not care enough taken by many farmers in the selection of seed. Where no preference is expressed the merchant is liable to dispose of the poorer seed. Farmers are sometimes in a hurry, and when the seed they usually plant can not be readily had, they take almost any kind. The selection of seed should be done before the rush of planting time, when care can be exercised. Our advice to farmers is never to buy seeds of doubtful character, and to dealers never to handle them. By working together poor seed will be driven from the market, the business of reliable seedsmen become less precarious, and the crops of the farmer more certain."

Seeds dipped in a solution of corrosive sublimate in alcohol, diluted with 10,000 parts of water, did not mold and germinated as well as those not thus treated.

Experiments with forage plants (pp. 161–169).—Brief descriptive notes on 39 varieties of forage plants grown at the station, including 24 varieties of grasses, alsike, red, white, and crimson clover, sweet clover (*Melilotus alba*), honey clover (*Melilotus cærulea*), alfalfa (*Medicago sativa*), black medic (*Medicago lupulina*), sanfoin (*Onobrychis sativa*), small pea (*Lathyrus sativus*), hairy vetch (*Vicia villosa*), bird's-foot clover (*Lotus corniculatus*), serradella (*Ornithopus sativus*), tar weed (*Madia sativa*), giant spurry (*Spergula maxima*).

The importance of the introduction of new grasses and other forage plants in Maine is urged, and lists of such plants which may be used in experiments for this purpose are given.

Injurious plants received for examination in 1889 (pp. 170, 171).—A list of 7 species of parasitic fungi and 7 of weeds.

The potato rot (pp. 172–181, illustrated).—The potato rot (*Phytophthora infestans*) was very prevalent in Maine in 1889. The origin, history, causes, and conditions of growth are stated; the fungus in its different stages is described; an account of its life history is given; and direct and preventive measures of treatment are suggested. The article is illustrated with a plate taken from the Agricultural Report of Maine for 1882.

Apple scab (pp. 182–184).—This includes abstracts of reports of Professors Taft and Goff on experiments with fungicides for apple scab (*Fusicladium dendriticum*) in Michigan and Wisconsin (See Bulletin No. 11, Section of Vegetable Pathology, U. S. Department of Agriculture, pp. 22–38), and is illustrated with a copy of a plate from the Report of the U. S. Department of Agriculture for 1887.

Weeds (pp. 185–187).—Notes on false flax or gold of pleasure (*Camelina sativa*), and rib-grass or English plantain (*Plantago lanceolata*, L.).

Miscellaneous insects (pp. 188, 189).—Brief notes on the forest tent caterpillar, codling moth, fall canker-worm, white-marked tussock moth, and May-beetle.

Apple maggot (pp. 190–241, illustrated).—A detailed report of studies by the author on the apple maggot (*Trypeta pomonella*, Walsh). The article includes a bibliography of this insect, its history and distribution, an account of the work of the author on the maggot in 1888–89, a tabulated record of observations in 1888, a discussion of the author's observations, a list of varieties of apples known to be affected by the maggot, notes on the spread of the maggot from one variety to another, a technical description of the insect in its various stages, an account of its life history, a discussion of remedies, and critical remarks on the anatomy and life history of the maggot. The illustrations consist of 4 plates containing 26 figures, a number of which are from original drawings. Some of the most interesting results of these investigations are given below.

The author discovered and observed the eggs of the maggot in the apple and also in the ovary of the insect. The eggs and ovipositor are described as follows:

Eggs.—Length, 0.8 to 0.9 mm. (0.032 to 0.036 inch); breadth, 0.2 to 0.25 mm. (0.008 to 0.009 inch); white in the oviducts, but light yellow when taken from the fruit; fusiform and about four times as long as wide; pedicellate at the end; pedicel about one twentieth of the length of the egg, longer than broad, and rounded at the end; pedicellate end broadest and abruptly sloping into the pedicel, other end more sloping. The shell of the egg at the pedicellate end, for one fourth of the length, is pitted with irregular, hexagonal cells, the borders of which are raised and lacerated, giving a roughened or spinose appearance to the surface; sculpture most prominent near the pedicel and gradually lost in the general surface, which is smooth; the spinose portion is darker. The larva is placed in the egg with the head away from the pedicel and the end containing the head is inserted into the apple. Ovaries double and saccate, occupying most of the abdominal cavity, each side containing twenty-four chains of eggs, each chain at least seven eggs in different stages of development. Perfect eggs and stages of development are shown in one of the plates accompanying the article. * * *

Ovipositor.—Length, 1.33 mm. (0.053 inch); breadth, 0.33 mm. (0.0133 inch) at the middle, where it enters the sheath, broadest at the base, tapering where it leaves the sheath to a sharp point somewhat curved (usually upward) at the end; brownish; hornlike; bearing a median groove below, which is covered by two flaps which extend half way from the sheath to the point. These flaps are covered by a shorter median one. From beneath the flaps the eggs escape. In specimens mounted in balsam the oviduct and ovipositor show within the sheath to its base. * * *

Life history.—In early seasons, under favorable conditions, the flies in Maine begin to emerge about July 1, and earlier in the States farther south. They continue to emerge all summer, and are on the wing in abundance until the middle or last of September and occasionally in October. Early frosts check them. The flies lived three weeks in confinement and will probably live longer in nature. They begin to deposit their eggs in the early fruit by July 1 or earlier, and egg laying continues while the flies are on the wing—the earlier races of flies affecting the earlier varieties and the later races the fall and winter fruit. Each female is capable of laying at least between three and four hundred eggs, which are inserted from time to time one in a place by means of a sharp ovipositor through the skin of the apple. The eggs being successively developed in the ovary of the female, after the manner of the barn-yard fowl, the season of egg laying extends over considerable time. The eggs are vertically inserted into the pulp of the apple, with the end opposite the pedicel, which contains the head of the maggot, pointing toward the core. The eggs are deposited in all parts of the apple, usually upon the cheeks, sparingly near the calyx and stem ends, and more abundantly upon the pale or shaded side of the fruit. The time required to deposit the eggs is about one half minute. By means of the sharp ovipositor a characteristic puncture, 0.33 mm. (0.0133 inch) in diameter, is made through the skin of the apple. These punctures can be detected by careful observations with the naked eye, but a pocket lens is necessary to see them well. They appear as brownish specks, and have not been before distinguished from the brownish, rusty spots common on apples. Under the glass they appear as circular or oblong openings, surrounded by a brownish border, somewhat shrunken by the shriveling of the tissue beneath. They may be numerous on the same apple. The eggs hatch in 4 or 5 days under favorable conditions, and the minute larvæ begin at once to work in the pulp of the apple. * * *

They attain their growth, under favorable circumstances, in 4 or 5 weeks, but their development may be arrested by cold, insufficient food, hardness of the fruit, etc., for a great length of time. Ordinarily they remain in the fruit but a short time after they mature. * * *

Fruit picked from the trees may contain larvæ, and often stored or marketed fruit is alive with maggots. The exit openings are characteristic—irregular holes about 2 mm. (0.08 inch) in diameter, surrounded by a brownish border. They look as though the maggots had gnawed a hole for the head and then forced the body through, leaving a lacerated border. They may occur anywhere on the apple, but are more frequently found where the brown larvæ trails show through the skin. They begin to appear in the early apples about the 1st of August, and may be found until frost in windfalls, and in the stored fruit as long as the larvæ remain.

It would seem that the development of the larvæ is so nicely timed that they are not mature until the fruit is ripe. Their development is slower in late and hard fruits. A dozen maggots may infest the same apple, though a single one is enough to render it worthless. The maggots have been found in numerous varieties—early and late, sweet, acid, and subacid—extending from early in July through August, September, October, November, December, January, and February. The larvæ usually leave the apples and go into the ground an inch or less and soon change to the pupæ state. The pupæ are occasionally found within the fruit in windfalls and quite frequently in stored fruit. Sometimes the larvæ change on the surface of the ground under decaying fruit. On grass ground they probably change in the débris about grass roots. In the bottom of boxes, bins, and barrels, where infested fruit is stored, pupæ may be found in abundance.

In discussing remedies the author combats the idea that the cutting down of the early varieties of apple-trees would destroy the maggot.

The destruction of our early fruit trees, excepting a few to be left as traps, has been suggested. This method is based upon the erroneous belief that *Trypeta* works only in early fruits. If we raised no early fruit the early flies would do no harm. The destruction of the larvæ from these trap trees would not lessen the ravages of the later-appearing races of flies upon late fruits. Destroying the early fruit would force many of the early-appearing flies to find a nidus for their eggs in the later fruit, thus increasing the number of later flies.

The destruction of the windfalls and the burning of refuse from bins and barrels are urged as the most effective means of repressing the maggots.

Insecticides (pp. 242–254, illustrated).—Directions for the use of insecticides are given and various forms of spraying apparatus are described and illustrated.

List of fruits growing at the station (pp. 255, 256).—This includes 33 varieties of apples, 13 of plums, 1 of pears, 4 of cherries, 14 of grapes, 2 of currants, 1 of gooseberries, 4 of blackberries, 8 of raspberries, and 17 of strawberries.

REPORT OF VETERINARIAN, F. L. RUSSELL, V. S. (pp. 257–266).—This contains accounts of hog cholera and parturient apoplexy in cows, with special reference to the symptoms of these diseases and their treatment.

REPORT OF METEOROLOGIST, M. C. FERNALD, PH. D. (pp. 267–281).—"For 20 years meteorological observations have been taken at the Maine State College, and summaries of the same have been published yearly in the college reports. These summaries relate to the larger part of the phenomena regarded as meteorological.

"It is not the purpose of the station to duplicate this work of the college, but rather to make a somewhat careful study of certain meteorological conditions, an acquaintance with which can not fail to be of value to those engaged in practical agriculture."

Tabulated summaries are given of observations with the hygrometer in a forest and in an open field, with soil thermometers at depths of from 1 to 36 inches, with terrestrial and solar radiation thermometers, and of the velocity of the wind and the amount of rain-fall. Detailed records of similar observations are also given for the month of June, 1889.

CO-EFFICIENTS OF DIGESTIBILITY FOR PROTEIN, W. H. JORDAN, M. S., AND L. H. MERRILL, B. S. (pp. 282–285).—This is a comparison of the co-efficients of digestibility of protein as obtained (1) with animals in the ordinary manner; (2) by making an allowance in these tests for the fæcal nitrogen soluble in ether, alcohol, hot water, and lime water, and (3) by pepsin-pancreas digestion on numerous feeding stuffs. The results by the second method averaged 11 per cent higher than by the first. The results by the second method agree very closely with those obtained by artificial digestion.

LOSS OF FOOD AND MANURIAL VALUE IN SELLING SWEET-CORN, J. M. BARTLETT, M. S. (pp. 286, 287).—Tabulated data are given for four lots of corn, showing the relation of parts of the plant and their composi-

tion with reference to food and fertilizing ingredients. From these "it can be seen that the kernels contain only about 21 per cent of the total phosphoric acid, 22 per cent of the potash, and 41 per cent of the nitrogen" contained in the crop.

Massachusetts State Station, Bulletin No. 39, April, 1891 (pp. 12).

METEOROLOGICAL SUMMARY (p. 1).—This is for 8 months ending February 28, 1891.

TREATMENT OF FUNGOUS DISEASES, J. E. HUMPHREY, B. S. (pp. 2–12, illustrated).—General principles of treatment are briefly discussed; directions are given for the preparation of several common fungicides; and various forms of spraying apparatus are described and illustrated.

Massachusetts State Station, Circular, March, 1891 (pp. 8).

COMMERCIAL FERTILIZERS, C. A. GOESSMANN, PH. D.—This circular contains the trade values of fertilizing ingredients adopted for 1891; instructions to manufacturers, agents, and sellers of commercial fertilizers, calling their attention to the fertilizer law of the State; and analyses of samples of wood ashes, cotton-seed-hull ashes, wool waste from factories, and muck sent to the station for examination.

Massachusetts Hatch Station, Bulletin No. 12, April, 1891 (pp. 32).

REPORT ON INSECTS, C. H. FERNALD, PH. D. (illustrated).—Original and compiled notes on the following insects: Bud moth (*Tmetocera ocellana*, S. V.), spittle insects (*Philænus spumarius* and *P. lineatus*, Linn.), squash-bug (*Anasa tristis*, De Geer), pea-weevil (*Bruchus pisi*, Linn.), bean weevil (*Bruchus obsoletus*, Say.), May-beetle (*Lachnosterna fusca*, Fröhl.), plum curculio (*Conotrachelus nenuphar*, Herbst.), onion maggot (*Phorbia ceparum*, Meig.), cabbage butterfly (*Pieris rapæ*, Linn.), apple-tree tent caterpillar (*Clisiocampa americana*, Harr.), forest tent caterpillar (*Clisiocampa disstria*, Hübner), stalk borer (*Gortyna nitela*, Guen.), pyramidal grape-vine caterpillar (*Pyrophila pyramidoides*, Guen.), grape-berry moth (*Eudemis botrana*, S. V.), codling moth (*Carpocapsa pomonella*, Linn.), cabbage-leaf miner (*Plutella cruciferarum*, Tell.), and gartered plume-moth (*Oxyptilus periscelidactylus*, Fitch). The bulletin is illustrated with 26 figures.

Massachusetts Hatch Station, Meteorological Bulletin No. 27, March, 1891 (pp. 4).

This includes a daily and monthly summary of observations for March, 1891, made at the meteorological observatory of the station, in charge of C. D. Warner, B. S.

Michigan Station, Bulletin No. 71, February, 1891 (pp. 10).

SUGAR BEETS, R. C. KEDZIE, M. D.—Brief statements regarding the climate, soil, and methods of cultivation suitable for the cultivation of the sugar-beet, and the outlook for the establishment of the beet-sugar industry in the United States. Temperature and rain-fall charts for Lansing, Michigan; Halle, Germany; and Cambrai, France, are given, which indicate that "the southern two thirds of the lower peninsula of Michigan has a climate admirably adapted to the growth of sugar-beets." The bulletin also contains the outlines of a plan for co operative experiments in raising sugar beets in different localities of Michigan, which the station proposes to undertake during the coming season.

Michigan Station, Bulletin No. 72, February, 1891 (pp. 6).

SIX WORST WEEDS, W. J. BEAL, PH. D.—Descriptive notes on the Canada thistle (*Cnicus arvensis*), red-root (*Lithospernum arvense*), moth-mullein (*Verbascum blattaria*), toad-flax (*Linaria vulgaris*), rib-grass (*Plantago lanceolata*), and curled dock (*Rumex crispus*), with suggestions as to means for their repression. Specimens of the seeds of each species accompany the bulletin.

Minnesota Station, Bulletin No. 15, February, 1891 (pp. 10).

WHEAT EXPERIMENTS, D. N. HARPER, PH. D. (pp. 65–72).—Brief accounts of experiments with wheat in 1890, in the following lines: tests of native and foreign (Russian and Hungarian) varieties; mixtures of different varieties; seeds of different densities; effects of cleaning the seed; and the continuous seeding of the same wheat on the same land. There is also an outline of proposed co-operative experiments with Scotch Fife wheat in 1891. The following statement of conclusions is taken from the bulletin:

The best wheats for our conditions are the varieties of pure Scotch Fife and pure Blue Stem. For the Red River Valley, particularly the northern portion of it, Scotch Fife is for all reasons the best. It ripens earlier than Blue Stem and makes better flour, for the reason that the bread made from it is of lighter color than bread made from Blue Stem flour. I have made some analyses of the best Blue Stem wheat, where the amount of gluten and the strength of the dough were equal to the best Scotch Fife, and where milling tests showed it to give as great a yield, but in all cases the color of the dough made from Blue Stem flour was noticeably darker.

From many analyses made on last year's crop I observed that Blue Stem stains more readily than Fife. Much of the wheat of last year's crop was discolored, an effect of the excessive heat in July. In all cases I examined it was the Blue Stem grains which were most injured. Wheat which was plump, rich in gluten, and well cured would have been of high milling value had it not been for discolored grains, and these were mostly grains of Blue Stem. * * *

Selection of seed.—The most important points to be considered in the selection of wheat for seed are as follows; Secure (1) a pure variety of wheat—the best being

Fife; (2) a heavy wheat; (3) a plump wheat, with the shape of the berry as near a sphere as possible; (4) a clean wheat, that is, one free from weed seeds, shrunken and immature grains. * * *

But the selection should take place in part before harvesting. If of pure variety that wheat which ripens earliest, with the brightest, strongest straw and largest heads will generally prove to have all the requirements of good seed. By this continued intelligent selection, accompanied by careful change of seed, the quality of our wheat must improve if methods of cultivation are correct.

Mississippi Station, Third Annual Report, 1890 (pp. 43).

FINANCIAL REPORT (p. 4).—This is for the year ending June 30, 1890.

REPORT OF DIRECTOR, S. M. TRACY, M. S. (pp. 5, 6).—Brief statements regarding the buildings, equipment, publications, and organization of the station. Three branch stations for work in special lines have been located at Holly Springs, Lake, and Ocean Springs. The last-mentioned station is on the Gulf coast and is for experiments with semi-tropical fruits, rice, and sugar-cane.

FIELD EXPERIMENTS WITH COTTON (pp. 7–20).—These included experiments with fertilizers, methods of culture, and varieties.

Cotton, fertilizer experiments.—These were conducted at the station and at Holly Springs. The principal fertilizers used were kainit, cotton-seed meal, cotton seed, stable manure, sulphate of potash, acid phosphate, and nitrate of soda. Details are given in notes and tables. The general results of these and previous experiments by the station are summed up as follows:

The station has been in existence 3 years and has tested about fifteen fertilizers each season on the yellow-clay soils which are typical of the hill regions of the State. In nearly all cases plats have been duplicated each season, and in many cases three or four plats have been used as duplicates. It has been our uniform experience during three seasons that the purchase of concentrated nitrogenous fertilizers is not profitable; that acid phosphate alone is only occasionally profitable; that potash fertilizers, either in the form of kainit, sulphate of potash, or ashes, have always given a fair profit. We have also found that a fertilizer containing a large percentage of potash with a smaller amount of phosphoric acid has invariably given a greater net profit than has any single commercial salt. While good results have always been obtained by the use of a mixture of potash and phosphoric acid salts, results have been still better when the soil has received a fair supply of vegetable matter in addition. Whether this vegetable matter is derived from composting the commercial salts with meal, cotton seed, or stable manure seems to make but little difference, though if manure is used much more will be required than of the meal or seed. The work has been mainly to determine as far as possible the elements most needed, which, as stated above, appear to be a liberal supply of potash, to which should be added some other material which will furnish a smaller amount of phosphoric acid and nitrogen, together with the necessary vegetable matter. At present prices kainit is the cheapest form in which to buy potash, while the other elements needed may be furnished in cotton seed, cotton-seed meal, or stable manure, the choice depending on the local supply of each available.

The work accomplished so far seeming to indicate so plainly the elements needed, the future work of the station will be directed mainly toward ascertaining amounts of each which can be used with profit and the best methods and times of application.

On the so-called "black prairie" soils a large number of different fertilizers have been tried, but no definite results have been secured which indicate the proper combination to make such soils productive for cotton. The growth of the plant on these soils is as strong and vigorous as could be desired; the crop usually promises well until August, when the bolls begin to drop without maturing; the final yield is always very light, and none of the ordinary fertilizers seem to have any effect. Work upon such soils will be continued during the coming season both at the station and at another point farther east.

A thorough chemical and biological study of the cotton plant was commenced in May and was continued until the crop matured, but is not yet finished. Complete analyses were made of the roots, stems, leaves, and bolls once in 10 days, in order to ascertain the periods at which different fertilizing elements are taken up most rapidly and the amounts used by the different parts of the plant. This work will require considerable time, but it is essential to a full understanding of the subject of economic fertilization and will be continued until completed.

Cotton, methods of culture.—In 1890, as in 1889, shallow cultivation gave a larger yield than deep cultivation.

Cotton, test of varieties.—Tabulated data are given for 37 varieties grown in 1890.

The heaviest yield of seed cotton per acre was from King, which gave 1,270 pounds. The greatest yield of lint was from the Cherry Long Staple, which gave 420 pounds, or 46.6 per cent of the seed cotton. This is the largest per cent of lint obtained from any of the varieties and nearly 15 per cent higher than the average. Only one other variety, the Petit Gulf, gave over 40 per cent of lint, the average being 31.8 per cent. Both of these were grown from seed 3 or 4 years old. * * * The six varieties succeeding best were Cherry Long Staple, yielding \$41.34 per acre; King, yielding \$39.61 per acre; Southern Hope, yielding \$33.03 per acre; Extra Early Carolina, \$31.65 per acre; Truitt's Premium, \$31.26 per acre; Tennessee Gold Dust, \$30.03 per acre.

The average weight of seed cotton per acre was 719 pounds, and the average weight of lint cotton per acre was 231 pounds.

These results are compared with those of similar experiments recorded in the Annual Report of the station for 1889 (See Experiment Station Record, Vol. II, p. 410). There are also brief notes on 7 varieties grown on the college farm and on 3 varieties grown at Holly Springs.

FIELD EXPERIMENTS WITH CORN (pp. 20–26).—These include experiments with fertilizers and varieties and in topping and stripping corn. Previous experiments with corn were recorded in the Annual Report of the station for 1889 (See Experiment Station Record, Vol. II, p. 411).

Corn, fertilizer experiments.—Experiments at the station and at Holly Springs are recorded, a number of different fertilizers being used, as in the case of cotton. The results do not admit of general conclusions.

Corn, test of varieties.—Tabulated data are given for 458 varieties grown on a rich black loam soil. The 6 varieties giving the largest yields per acre were Mosby's Prolific 63, Cocke's Prolific 55, Minter's Prolific 54, Bailey 51, Mammoth Surprise 48, and Evans 47 bushels. The average yield per acre of the white varieties was 37; of the yellow varieties, 34.5; and of the flint varieties, 14 bushels. The results

in 1889 and 1890 indicate that the flint varieties are not suited to this locality. In both years the white varieties have averaged much larger yields than the yellow varieties.

Corn, topping and stripping.—"It is a very common practice in this State to strip the leaves or cut the tops from the growing corn as soon as the grain begins to ripen. As a test of the economy of this practice one half acre was topped July 12 and another half acre was stripped July 30, equal areas being left untouched on each side of each plat, and the corn gathered, when fully ripe, for comparison." The financial results, as estimated per acre, are as follows: topped, $23; stripped, $28.53; untouched, $30.45.

FORAGE PLANTS (pp. 26–33).—In 1889 the station began the testing of numerous species of forage plants in co-operation with the U. S. Department of Agriculture. The details of this work will be published in a bulletin of this Department. The main object of these tests has been to find a plant which will afford winter pasturage and which will not be run out by other plants occupying the ground during the summer months. This article contains a summary of the results with a few species which have been successfully tried in this region and a few which have proved of doubtful value. The promising species include orchard grass (*Dactylis glomerata*), rescue grass (*Bromus unioloides*), water grass (*Paspalum dilatatum*), carpet grass (*Paspalum platycaule*), Terrell grass (*Elymus virginicus*), Texas blue-grass (*Poa arachnifera*), redtop (*Agrostis vulgaris*), crab-grass (*Panicum sanguinale*), Bermuda grass (*Cynodon dactylon*), Johnson grass (*Sorghum halepense*), Japan clover (*Lespedeza striata*), alfalfa (*Medicago sativa*), melilotus (*Melilotus alba*), and Mexican clover (*Richardsonia scabra*). The following seem to be of little value in this section: timothy (*Phleum pratense*), Kentucky blue-grass (*Poa pratensis*), meadow foxtail (*Alopecurus pratensis*), fescues, rye grasses, and red clover (*Trifolium pratense*).

FEEDING FOR MILK AND BUTTER (pp. 33–35).—Brief account of an experiment reported in detail in Bulletin No. 13 of the station (See Experiment Station Record, Vol. II, p. 362).

HORTICULTURAL WORK (pp. 35–38).—Brief notes are given on 13 varieties of grapes and on experiments in 1889 and 1890 in growing a fall crop of potatoes, planted about the middle of August.

BOTANICAL SURVEY (p. 38).—The botanical survey of the State, begun in 1889, has been continued. Thus far about 1,400 species of native plants have been identified and located.

CHEMICAL WORK (pp. 38–42).—Analyses of fertilizers, soils, marl, butter, and sorghum are reported. Analytical work on the cotton plant at different stages of its growth and on grasses is in progress.

METEOROLOGICAL SUMMARY (p. 43).—Tabulated data for each month of 1890. The averages for the year were as follows: temperature 64.9°, relative humidity 81.4, total rain-fall 55.05 inches, total hours of sunshine 2,561.5.

Mississippi Station, Bulletin No. 14, March, 1891 (pp. 40).

INJURIOUS INSECTS, H. E. WEED, M. S. (illustrated).—Notes on the life history of the following insects, with suggestions as to means for their repression: screw worm (*Compsomyia macellaria*), pea-weevil (*Bruchus pisi*), bean weevil (*Bruchus obsoletus*), striped cucumber beetle (*Diabrotica vittata*), peach tree borer (*Sannina exitiosa*), ox-warble fly (*Hypoderma bovis*), plum curculio (*Conotrachelus nenuphar*), and codling moth (*Carpocapsa pomonella*). Directions are given for the preparation and use of the following insecticides: Paris green, London purple, tobacco, kerosene emulsion, white hellebore, pyrethrum, and bisulphide of carbon. Spraying apparatus of various kinds is described and illustrated.

New York State Station, Bulletin No. 26 (New Series), January, 1891 (pp. 27).

HISTORY, USE, AND ANALYSES OF FERTILIZERS, P. COLLIER, PH. D. (pp. 388–415).—This is a popular treatise on the history and the general principles underlying the use of commercial fertilizers, together with the tabulated results of analyses of 35 samples of fertilizers collected in New York during the fall of 1890. The latter include bones, dried blood, dissolved bone-black, potash salts, and mixed fertilizers.

North Carolina Station, Annual Report, 1889 (pp. 16).

This includes an outline of the work in the several divisions of the station, a list of the bulletins issued in 1889, and a financial report for the year ending June 30, 1889.

North Carolina Station, Bulletin No. 74, December 31, 1890 (pp. 20).

WORK OF THE HORTICULTURAL DIVISION, 1890, W. F. MASSEY, C. E.—This includes accounts of tests of vegetables and fruits, and directions for the culture of figs. Variety tests at the station will hereafter be confined chiefly to the new sorts. The main work in horticulture will be in cross-fertilization and the growing of improved varieties from seed. Especial attention will be given to grapes. A grapery for the cultivation and crossing of grapes under glass has recently been completed.

Notes and tabulated data are given for 13 varieties of sweet-potatoes, 62 of peas, 17 of potatoes, and 39 of tomatoes. There are also brief notes on experiments with cabbages, sweet-corn, strawberries, raspberries, blackberries, grapes, figs, and ornamental plants.

"A large portion of North Carolina is well adapted to the culture of the fig, and in every part of the State a supply for home use can be had by taking a little trouble in growing the trees in proper shape for protecting them in winter." The author advises that where frosts are severe

enough to injure the trees they should be grown in the form of spreading shrubs, branching from the ground. After the leaves have fallen the branches may be gathered together in four bundles, bent down to the ground in the outline of a cross, fastened with wooden pegs, and covered with boughs or earth. The amount and kind of covering should be varied according to the severity of the climate.

North Carolina Station, Bulletin No. 74*b* (Meteorological Bulletin No. 16), January 31, 1891 (pp. 16).

METEOROLOGICAL SUMMARY FOR NORTH CAROLINA, JANUARY. 1891, H. B. BATTLE, PH. D., AND C. F. VON HERRMANN.—Notes on the weather, and monthly summaries and tabulated daily record of meteorological observations by the North Carolina weather service. The bulletin is illustrated with maps of North Carolina, showing the isothermal lines and the total precipitation for different parts of the State.

Oregon Station, Bulletin No. 9, February, 1891 (pp. 8).

SILOS AND SILAGE, H. T. FRENCH, M. S.—An account of the station silo and of experiments in storing and feeding silage, with a brief discussion of the advantages of the silo in portions of Oregon where the moist climate prevents the successful storage of crops in barns or stacks.

Oregon Station, Bulletin No. 10, April, 1891 (pp. 34).

SPRAYING EXPERIMENTS, F. L. WASHBURN, B. A. (pp. 3–22, illustrated).—Experiments with Paris green for the codling moth and with a combined fungicide and insecticide for apple scab and the codling moth are described, details being given in tables. It was found that a combination of whale-oil soap, sulphide of sodium, and Paris green was more effective than Paris green alone. Spraying machinery of various kinds is described and illustrated.

THE HOP LOUSE, F. L. WASHBURN, B. A. (pp. 23–34, illustrated).—An account of observations by the author on the hop louse (*Phorodon humuli*), which was very injurious to hops in Oregon and Washington in 1890, together with an illustrated life history of the insect from publications of this Department, and suggestions as to means for its repression.

Rhode Island Station, Bulletin No. 9, December, 1890 (pp. 23).

EXPERIMENTS IN APICULTURE, S. CUSHMAN (pp. 99–110).—This is a continuation of the report on work in apiculture contained in Bulletin No. 7 of the station (See Experiment Station Record, Vol. II, p. 295).

The use of artificial heat to promote brood rearing.—An experiment was begun May 14, 1890, with two colonies (Nos. 4 and 14) which had

been wintered in the cellar of the station farmhouse, and were in about the same condition. Thermometers were so placed that "each hive had one in the cluster and another in the most remote part of the hive body, outside of the cluster, and both of these could be read without disturbing or exciting the bees."

[When the experiment was begun] four thick stone bottles, each holding a half pint, were filled with boiling water and placed back of the division board in hive No. 4. This was renewed each morning and evening until June 20, while a record was kept of the thermometer readings for the remainder of the month. The next morning before the water was renewed the common thermometer outside the brood nest in No. 4 stood at 68°, while in No. 14 it was at 66°. The artificial heat had apparently increased the temperature of the empty corner of the brood chamber, leaving it at the end of 12 hours 2 or 3 degrees higher than the same space in the other hive. The thermometer among the bees of No. 4 showed a temperature of 86°, both in the morning and at night, while in No. 14 it stood at 84° and 87°. The records for the rest of the month showed that where the heat was used the average temperature of the cluster at night and in the morning was no higher, and that when there was any difference between the two the temperature of the cluster where the heat had been given was the lower. * * * The records also show that the temperature of the hive outside of the cluster, 12 hours after the hot water was renewed, was many degrees higher than where none had been given. * * *

The weather much of the time was very cold and changeable. The artificial heat was of the greatest value during the night and on chilly or sunless days, and better enabled the bees to cover the additional number of eggs and larvæ that they had started to rear during warm, sunny days. * * *

On May 31, at 11 o'clock, and just before the thermometers were removed for the season, the one in the cluster in No. 4 indicated 94°, and out of the cluster 73½°. The bees then covered seven combs, one of which contained honey while six were full of brood. Those in No. 14 registered in the cluster 94°, out of cluster 71°. Of the seven combs, one was empty, another was full of honey, and five were quite well filled with brood, and six of these were covered with bees. No. 4 steadily gained in bees and brood up to June 20, when the artificial heat was discontinued. No. 4 overflowed the brood nest long before No. 14 had used all the combs, and by July 1 occupied two brood chambers and was about twice as strong.

Both were run for extracted honey, and on July 18 the honey was extracted from the upper story of each. The amount obtained from No. 4 was 35 pounds, and from No. 14, 15 pounds. There remained in the lower story of the latter 3 or 4 pounds more than in No. 4. As the building of queen cells in No. 4 soon caused us to remove the queen for a time and changed the conditions, the colonies could no longer be compared, and this ended the experiment. * * *

Before such an application of artificial heat can be generally recommended further work should be done, with the conditions more favorable for accurate comparison, and on a more extensive scale. In this case apparently just enough heat was given, and in such a way as to increase the rearing of brood without causing an abnormal condition of the colony, a much larger amount of surplus honey being thus secured.

A doubled colony.—"On July 5 one of the best colonies was removed to the stand [on scales]. The bees of this colony that had been in the field would go back to the old stand. To offset this and make the colony more powerful we gave them the combs of capped brood from another colony, with the young bees on them and not able to return." A tabular record of the gains and losses in weight of the honey in the

hive, as indicated by the scales, is given for each day from June 6 to October 27, inclusive.

The principal sources of supply during June were the blossoms of white clover, blackberry, and charlock or chadlock (*Brassica Sinapistrum*), or a species of wild mustard. * * * The honey was of a light amber color and the mustard flavor was plainly noticeable. The fall honey was gathered from a late species of golden-rod, and the various species of wild aster or frost weed, which grow here in abundance. Aster honey is a pale amber, and when ripe, or after its weedy odor and flavor have passed off, is very thick, clear, and sparkling, and has a delicious flavor, while golden-rod honey is darker and thinner, and has a rather strong or rank flavor.

The amount of surplus taken from the scale hive was 70 pounds. When packed for the winter the colony was left with two brood chambers, in each of which was an abundance of natural stores well ripened and sealed. This colony made no attempt to swarm during the season. The queen was raised the year before. * * *

In this locality, where there are occasional flows of honey from spring to frost, if extracted honey is the object and no increase in the number of colonies is desired, this plan of doubling or giving one colony the bulk of the bees and brood from another will give the best results. The doubling should be done just before the colonies get in condition to swarm. If the colony has a young queen, and is given sufficient room, ventilation, and protection from the sun, they will rarely attempt to swarm.

Carniolan bees.—The author's experience with bees of this variety indicates that, while they possess many desirable qualities as honey gatherers, they are much inferior to the best Italian bees. They show a great tendency to swarm, and the claim that they do not gather propolis like other races, but stop cracks with wax, is not warranted.

Imported Carniolans, if kept entirely pure and given management especially suited to them, may be of value for the production of comb honey, as well as for the purpose of quickly building up a large apiary for queen rearing. They may be of value for judicious crossing with other races to secure a better strain for comb-honey production, but this work is best done by the skilled breeder. We would advise the average bee keeper to use American Italians in the production of extracted honey as well as to get the greatest quantity of comb honey, but to produce the finest comb honey common black bees, or blacks and Italians crossed, are the best.

FOUL BROOD, S. CUSHMAN (pp. 111–121, illustrated).—An account of the bacterium (*Bacillus alvei*) causing foul brood, the symptoms of the disease, the remedies which may be employed to destroy the germs, and the methods of repressive and preventive treatment. Particular reference is made to successful experiments by Messrs. Sproule and Webster with formic acid.

South Dakota Station, Bulletin No. 20, January, 1891 (pp. 32).

FORESTRY, C. A. KEFFER (pp. 31–60).—A monthly record of rainfall, temperature, and direction of the wind at the station from September, 1888, to December, 1890, inclusive; diagram of the forest-tree plantation of the station, showing the arrangement of the plats and the varieties of trees growing on each plat; notes on the methods of planting and cultivation of the experimental plats in 1889 and 1890, with tabulated data regarding the growth of the different varieties;

similar data for the forest-tree and evergreen nurseries, and the seedling forest-tree plat; physical analyses of the soil of the experimental plats; observations on the root growth of transplanted trees; notes on the insect enemies of forest-trees in the State; and a discussion of the value of a dense leaf canopy. This bulletin is a report of progress in lines of work previously recorded in Bulletins Nos. 12 and 15 of the station (See Experiment Station Record, Vol. I, pp. 20 and 315). The soil of the station plantation is a black mixture of sand, clay, and organic matter underlaid by clay. Observations indicate that the roots of forest-trees are able to penetrate the clay subsoil.

The cotton-wood leaf beetle (*Lina scripta*), elm saw-fly (*Cimbex americana*), emperor moth (*Platysamia cecropia*), lilac borer (*Ægeria syringæ*), and the box-elder twig borer were especially troublesome in 1890.

From observation and information the author regards the following species as especially valuable for forest plantations in South Dakota:

Quick-growing, dense-shading trees.—Box-elder (*Negundo aceroides*), silver maple (*Acer dasycarpum*).

Slower-growing, more valuable trees.—Ash (*Fraxinus viridis* and *F. americana*), white elm (*Ulmus americana*), black wild cherry (*Prunus serotina*); and for deep soils in the southern part of the State, black walnut (*Juglans nigra*) and butternut (*J. cinerea*).

South Dakota Station, Bulletin No. 21, February, 1891 (pp. 16).

SMALL GRAIN, L. FOSTER, M. S. A. (pp. 63–76).—This includes accounts of experiments with wheat, rye, oats, and barley, in continuation of those reported in Bulletins Nos. 11 and 17 of the station (See Experiment Station Record, Vol. I, p. 19, and Vol. II, p. 132). The experimental plats were on a sandy loam upland, and were each one eighth acre in extent. The spring was very dry, and the hot winds of July severely damaged the crop.

Wheat.—Tabulated notes are given on 17 varieties, and brief descriptive notes on Lost Nation, which does well in the region of the station, and Ladoga, which in a three-seasons' test, has not proved satisfactory. There are also brief accounts of experiments in methods of seeding, cultivation, and top dressing. Experiments with varieties of winter wheat indicated that while these varieties were not winter-killed they could not endure the dry weather of the spring.

Winter rye.—Two varieties, Excelsior and a small common rye, were grown alongside the winter wheat and endured the drought well, yielding 24 bushels per acre. Experience in this section for the past 10 years indicates that winter rye may be successfully and profitably grown there.

Oats.—Tabulated notes are given for 25 varieties. White Bonanza, American Banner, Wide Awake, Black Tartarian, Dakota Gray, and White Surprise were deemed worthy of especial mention.

Barley.—Tabulated notes are given for 10 varieties.

Press drill vs. broadcast seeding.—The results of the experiments of 1890 in planting wheat and oats with a press drill and with a broadcast seeder agreed with those of two previous years in favoring the press drill.

South Dakota Station, Bulletin No. 22, March, 1891 (pp. 42).

INJURIOUS INSECTS, I. H. ORCUTT, M. D., AND J. M. ALDRICH, B. S. (pp. 77–118, illustrated).—Notes on the life history of the ash borer (*Ægeria fraxini*, Lugger), cecropia emperor moth (*Platysamia cecropia*, Linn.), sphinx moths, large willow (elm) saw-fly (*Cimbex americana*, Leach), small willow saw-fly (*Nematus ventralis*, Say), ash saw-fly (*Monophadnus bardus*, Say), the cotton-wood leaf beetle (*Lina scripta*, Fab.), the false chinch-bug (*Nysius angustatus*, Uhl.), cabbage butterfly (*Pieris protodice*, Boisd.), cabbage plusia (*Plusia brassicæ*, Riley), zebra cabbage-worm (*Mamestra picta*, Harr.), cabbage louse (*Aphis brassicæ*, Linn.), and cut-worms, with suggestions as to remedies. The bulletin is illustrated with 32 figures, a few of which are original. There are numerous references to observations and experiments by the author, and abstracts from the letters of a number of correspondents.

Utah Station, Bulletin No. 5, March, 1891 (pp. 22).

POTATO TRIALS, J. W. SANBORN, B. S. (pp. 1–16).—A preliminary report on experiments on methods of planting, tillage, and distance of planting of potatoes. The experiments were conducted on sandy loam soil with a gravelly subsoil, in a field about 160 feet above the Logan River. On 9 plats potatoes were planted in trenches and furrows and near the surface. Shallow and deep tillage were also compared with no tillage. On 25 plats potatoes were planted in hills, in rows 3½, 2½, and 2 feet apart, at distances of from 4 to 24 inches, and in squares at distances of from 20 to 40 inches. Analyses were made by W. P. Cutter, B. S., chemist of the station, with reference to the relation of distance and depth of planting and methods of cultivation to the starch and water in the potatoes harvested. The results of the experiments described in the article are thus summed up:

Summary of conclusions.—(1) The depth of planting did not materially affect the total yield of potatoes.

(2) Potatoes planted near the surface contained 23.1 per cent more starch than those planted deeper, and were, therefore, worth 33.4 per cent more for food, while being at the same time more palatable.

(3) Shallow tillage and even no tillage were more effective than deep tillage.

(4) The yield of potatoes decreased after passing 8 inches apart as the distance between the hills increased; the yield decreased when planted nearer than 8 inches.

(5) Increasing the distance between rows did not appear to decrease the yield. This fact is probably due to the decreased ratio of root cutting and might not hold true for a system of tillage that does not involve root cutting.

(6) Close planting resulted in an increase of moisture and in a decrease of starch of potatoes amounting to 7 per cent.

(7) The potatoes contained only 70.42 per cent of moisture. They contained 34.34 per cent more starch than those reported upon in the East, and therefore have 34.34 per cent more value than such Eastern potatoes.

(8) The practice of planting nearer than 3 feet between rows and 1 foot between hills should not be accepted as desirable until further inquiry in regard to the increased cost and decreased value of the product resulting from such close planting, is made.

(9) Quality should be regarded as one of the prime considerations in potato production, as potatoes are used more as a luxury than wheat.

(10) Utah potatoes being of very superior quality, require that our farmers maintain and even further develop this favorable quality, and in addition, make special effort to make known to possible markets their superior economical value and palatableness, for the reason that the distance to market beyond our border is so great that their superiority alone will secure for us sale in these markets, except in very infrequent years when crops are very short in the East and very great in Utah.

EXPERIMENTS WITH POTATOES, E. S. RICHMAN, B. S. (pp. 16–22).—These include experiments on twentieth-acre plats with different amounts of seed and of tillage, the effect of manure on the quality and composition of potatoes, and the effect of different amounts of water on the yield of potatoes. Small and large tubers, quarters, and two-eye pieces gave yields increasing with the amount of seed planted. In an experiment in which potatoes on different plats were cultivated at intervals of from 2 to 10 days from June 17 to July 19, the amount of cultivation seemed to have little influence on the yield. Where manure was applied, the percentage of starch was somewhat larger than on the plat receiving no manure. Where water was applied, between July 18 and August 6, in amounts varying from 4.3 inches to 9.45 inches, the yield increased with the increase in the amount of water. In a note by the director of the station the following are given as the average results obtained by him in experiments covering 7 years in localities further east.

Average product per acre for 7 years.

	Bushels.
From seed of whole potatoes, large	224.1
From seed of whole potatoes, small	177.0
From seed of stem end of potato	148.0
From seed of seed end of potato	168.0
From one eye to the hill	81.0
From two eyes to the hill	104.0
From three eyes to the hill	160.0

Vermont Station, Third Annual Report, 1889 (pp. 172).

FINANCIAL REPORT (p. 9).—This is for the fiscal year ending June 30, 1889.

REPORT OF DIRECTOR, W. W. COOKE, M. A. (pp. 10–16).—An outline of the work of the station.

INSPECTION OF FERTILIZERS, AND MISCELLANEOUS ANALYSES, W. W. COOKE, M. A. (pp. 17–41).—This includes analyses of 51 samples of commercial fertilizers and bones; analyses of leached and unleached

wood ashes, wool waste, marl, peat, muck, phosphate rock, iron ore, "germinator," cream of tartar, "fruit-preserving powder," drinking waters, and Hostetter's stomach bitters; a popular explanation of terms, and of fertilizer valuation; the trade values of fertilizing ingredients; a comparison of the average money value of the fertilizers licensed in 1888 and 1889; the text of the Vermont fertilizer law; and a list of manufacturers complying with the law in 1889.

ABSTRACTS OF BULLETINS (pp. 42-50).—Abstracts are given of Bulletins Nos. 15, 16, and 17, of the station, on the effect of fertilizers on the composition of corn, analysis of hay, testing milk at creameries, and test of dairy cows at the Vermont State Fair (See Experiment Station Record, Vol. I, pp. 156 and 320).

FEEDING TESTS OF MILCH COWS, J. L. HILLS, B. S. (pp. 51-84).—This is an account of an experiment made with five cows to test the relative feeding value of hay, corn fodder, corn silage (frosted and unfrosted), corn stover, the butts and the tops of corn stover, apple pomace silage, Hungarian grass silage, pea and oat hay, and pasture. The trial lasted from November 28, 1888, to May 22, 1889, and was divided into eight periods of three weeks each, the first week of each period being regarded as a transition period. The same grain ration was fed to all the cows during the entire experiment, viz., 2.5 pounds wheat bran, 1.5 pounds cotton-seed meal, 1 pound corn meal, and 1 pound gluten meal per day. The hay was substituted in separate periods in part or wholly by the other coarse fodders mentioned above, of which the animals were given more than they would eat, and the residue weighed back but not analyzed. "The financial aspect of the case is not considered in this article, but simply the relative amount of product obtained from the different fodders, without regard to their relative cost."

The tabulated data include the feeding record of each cow, analyses of the wheat bran, cotton-seed meal, gluten meal, corn meal, hay, fodder corn, corn stover (both upper and lower half of stalks), apple pomace silage, pea and oat hay and fodder, corn silage, and Hungarian grass silage fed; the yield and analyses of milk, and the amount of milk, solids and fat produced by each cow per pound of dry matter eaten for each of the several periods. The author discusses these at considerable length and draws the following conclusions:

(1) Corn fodder and corn silage from the same source had almost equal feeding value in products per pound of dry matter eaten; from different sources average silage proved better than average fodder; both corn silage and corn fodder proved superior to whole stover.

(2) The lower half of stover (butts) proved to have equal feeding value with the upper half (tops) pound for pound of dry matter in each.

(3) Hay and corn stover had much the same effect on milk production.

(4) Corn silage from frost-bitten corn poorly made proved inferior to that well made from unfrosted corn.

(5) Apple pomace ensiled, and used supplementary to and in part as a substitute for corn silage, is relished by cows, and appeared by four tests to be about equivalent in feeding value to corn silage.

(6) Pea and oat hay was not relished, but such as was eaten proved decidedly better, pound for pound, than any other fodder used.

(7) Good corn silage caused gain in all respects over good hay.

(8) Hungarian grass silage was fed at great loss as compared with corn silage. It gave with one cow the same (one a little better), with two others poorer results than did good hay, being, on the whole, of nearly equal value with it.

(9) The error inherent in feeding trials such as here reported may be considered to be, on the whole, approximately 4 per cent of the larger yield.

(10) Water below 40° Fah. was drunk as freely as when warmer, and less was drunk when the barn temperature was about normal (50° Fah.) than when warmer or colder.

(11) No relation was traced between nutritive ratio of fodders and products formed or between the albuminoids of the food and the casein of the milk.

(12) When changes in total solids take place the fat is the most likely to vary, casein next, and sugar and ash least.

(13) Generally speaking, as milk flow shrinks the percentage of solids increases, but the gross amount of solids decreases. Cows in calf change quality and quantity of milk more rapidly than farrow cows, and cows in pasture less rapidly than when barn fed.

(14) One season's experience indicates the following as true for the station herd: In changing from barn to pasture feed of equal feeding value, the quality of milk changes differently in different animals, there being usually a gain in per cent of solids, casein and sugar, and a loss in per cent of fat; the gross amounts of the ingredients almost invariably increase. Animal individuality plays so large a part in the marked change from barn to pasture feeding that the statement of the nature of the change in quality should not be understood to be of general application. Further work in this line is being carried out by this station.

FODDER ANALYSES, J. L. HILLS, B. S. (pp. 85, 86).—Tabulated analyses of Japanese buckwheat, fodder barley, fodder rye, cotton-seed meal, wheat bran, rice meal, hay, reed canary grass, orchard grass, brakes, hops, and sawdust with reference to food constituents, and of cotton-seed meal, rice meal, brakes, hops, and sawdust with reference to fertilizing constituents.

FODDER CROPS, W. W. COOKE, M. A. (pp. 87–98).—*Prickly comfrey, winter rye, and Japanese buckwheat.*—Brief notes on these crops, a statement of the yield and percentage of dry matter at different cuttings, and analyses of the buckwheat at five successive cuttings.

Varieties of silage corn.—Tabulated notes on 16 varieties of corn raised at the station. "Of these 16 varieties the Wisconsin Yellow Dent and the Pride of the North have done the best."

Growth of corn.—In a test "made to determine the proper time to cut corn, two fields of corn were used, one containing King Philip corn, planted May 25, and the other, Burrill and Whitman, planted May 29. Every fourth hill of each variety was cut August 7, August 16, September 13, and September 25." Tables show for each variety at each cutting the weight of green crop, amount of dry matter in the same, and the composition of the dry matter.

By September 13 the King Philip was fully glazed, while the Burrill and Whitman lacked considerable of this stage when the last of it was cut September 25. * * * It is worthy of note that on September 13 the total dry matter per acre in the King Philip was nearly as great as in the Burrill and Whitman, though the former was 9 feet high and the latter 13, while it is probable that each pound of dry matter in the King Philip was worth enough more than an equal weight of the Burrill and Whitman to make up for most of the difference in weight. This would seem to indicate that corn that will ripen should be cut as soon as it glazes, while the larger silage corn should, in this latitude, be allowed to stand as long as possible.

Effect of frost on corn fodder.—Analyses of samples of the same corn from cuttings made October 24 (somewhat frosted) and November 13 (after several severe frosts) showed a loss of 31 per cent of the albuminoids, 9.7 per cent of crude fiber, 22.7 per cent of nitrogen-free extract, 47.6 per cent of fat, and 33.4 per cent of ash in the crop harvested November 13.

Shrinkage of corn fodder in drying.—Analyses of samples of uncured corn fodder and of that cured in stooks out of doors and under cover. The loss of dry matter in curing amounted to 23.94 per cent in the fodder stooked indoors, and 28.89 per cent in that stooked out of doors.

Large and small stooks.—Weights and analyses are given of corn fodder kept from October 24 to December 10 in large and in small stooks. "The small stooks, six or eight in number, were as large as one person could conveniently bind, while the two larger stooks had at least half a ton of green fodder apiece. * * * The large stooks lost 13.65 per cent of the total dry matter, and the small stooks 15.15 per cent, so that in this case there was but little difference between the two methods. In both cases the loss fell most heavily on the nitrogen-free extract."

Changes that occur in the silo.—A record of silo temperatures and of the changes in weight in ensiling fodder corn. The silo, a small wooden tank, was filled with cut fodder corn, closely packed, and covered. The highest temperature, 80° Fah., was reached the second day after the silo was filled. There was a loss in ensiling of 14.67 per cent of the total dry matter in the original fodder corn. From the analyses given of the fodder corn and the silage "it will be seen that the loss falls almost entirely on the nitrogen-free extract."

REPORT OF HORTICULTURIST, C. W. MINOTT, B. S. (pp. 99–144).—This includes details of tests of seeds and of varieties of vegetables, and a list of the varieties of large and small fruits growing at the station.

Seed tests (pp. 99–115).—Tabulated data are given for tests of the vitality and purity of seeds of numerous varieties of vegetables and a few varieties of fruits, grasses, clovers, cotton, sorghum, dhoura, tobacco, etc. The seeds were of different ages and the results of the tests were quite various.

List of fruits growing at the station (pp. 121–123).—This includes 31 varieties of apples (6 Russian), 16 of cherries, 16 of pears, 16 of plums, 48 of grapes, 3 of quinces, 15 of blackberries, 2 of dew-berries, 15 of currants, 7 of gooseberries, 21 of raspberries, and 44 of strawberries.

Tests of varieties of vegetables (pp. 124–144).—Tabulated notes on 60 varieties of bush-beans, 22 of pole beans, 14 of beets, 12 of carrots, 11 of celery, 33 of dent corn, 20 of flint corn, 12 of pop corn, 45 of sweet-corn, 19 of cucumbers, 7 of summer squashes, 62 of tomatoes, 12 of turnips, and 8 of potatoes. With potatoes Northern and Southern-grown seeds were used and the results are compared with those of a similar experiment at the Maryland Station. The results at both places favored the home-grown seed, but the season was unfavorable for potatoes in both States.

REPORT OF ENTOMOLOGIST, G. H. PERKINS, PH. D. (pp. 145–163, illustrated).—Notes on a number of the more common insecticides and on the following insects injurious to elm trees: mourning cloak butterfly (*Vanessa antiopa*, Linn.), tussock moth (*Orgyia leucostigma*, S. & A.), canker-worm (*Anisopteryx vernata*, Peck), fall canker-worm (*Anisopteryx pometaria*, Riley), fall web-worm (*Hyphantria cunea*, Drury), elm borer (*Saperda tridentata*, Oliv.), elm-leaf beetle (*Galeruca xanthomelæna*, Schr.), May-beetle (*Lachnosterna fusca*, Fröhl.), elm bark-louse (*Gossyparia ulmi*, Geoff.), elm gall louse (*Schizoneura americana*, Riley), and cockscomb gall louse (*Colopha ulmicola*, Fitch).

Virginia Station, Bulletin No. 8, January, 1891 (pp. 23).

POTATO TESTS, W. B. ALWOOD.—The tests of varieties of potatoes were continued in 1890 in about the same way as those of the previous year, reported in Bulletin No. 6 of the station (See Experiment Station Record, Vol. II, p. 133). Tabulated data and descriptive notes are given for the most important varieties, including 10 early and 11 second-early varieties. There are also lists of 17 early, 67 second-early, and 7 late varieties tested. The percentages of water, dry matter, and starch, and the specific gravity are reported for 12 varieties from determinations made by W. Bowman, Ph. D., chemist of the station. The size of tuber to be used for seed, the planting of whole tubers or cuttings, the size of cuttings, methods of planting, and the use of fertilizers for potatoes are discussed. The results of the tests of varieties at the station and the views of the author regarding the culture of potatoes are summed up as follows:

(1) Of the early varieties, we recommend Essex Early, Early Hebron (Early Beauty of Hebron), Sunrise (Early Sunrise), Early Ohio, and Chas. Downing. The latter has most excellent characteristics, but may not be suited to all situations.

(2) Of the second-early sorts, we recommend Alexander, Beauty, Cream, Seedling No. 2, and Snow-Flake.

(3) Size of seed is of relative importance, according to what the grower may wish to accomplish. As a general statement all well-formed, sound tubers of the size of a hen's egg and upward are proper seed.

(4) Smaller seed is not to be commended, but may be used.

(5) Cutting seed is of much importance, both as to economy of seed used and even, uniform growth of crop. "Two-eye" pieces as a general rule are thought to be best.

(6) Small whole seed may, under some circumstances, be properly used, but large whole seed can not be used with profit.

(7) Medium or large whole seed will force the crop several days ahead of small cuttings, but the tubers cut in half crosswise will accomplish the same result.

(8) Trench culture, with the seed drilled one piece about a foot apart in the row, is better than surface or hill culture.

(9) To grow a profitable crop of potatoes requires a thoroughly prepared, fertile soil.

(10) Barn-yard manure which will undergo fermentation, should not be used on potato land, unless it is put on the fall before and thoroughly worked into the soil.

Virginia Station, Bulletin No. 9, February, 1891 (pp. 18).

TOMATOES, CULTURAL AND VARIETY WORK, W. B. ALWOOD (pp. 3–15, illustrated).—The investigations on tomatoes reported in Bulletin No. 4 of the station (See Experiment Station Record, Vol. II, p. 77) were continued in 1890.

A method of transplanting employed at the station is described and illustrated. Plants which have been grown in a hot-bed until they are 8 or 10 inches high are placed in a V-shaped trench 10 or 12 inches deep.

The plants, as taken from the bed, are placed along the smooth, nearly perpendicular bank of the trench, placing them about three to the inch, and firmly pressing the roots to the wall of the trench at such point as will hold the tops of the plants about even with the surface of the ground. After a short strip has been so placed, the trench should be filled up sufficiently to cover about 3 inches of the stem of the plant —cover at least above the cotyledons.

A V-shaped board covering is used to protect the plants from frost. "The plants can be safely held in a trench, as here shown, for a month or 6 weeks, and will become much more stocky without growing proportionately in height, and, what is more important, will come out with a very much enlarged root system." At the season for setting the plants taken from the trenches are placed in open furrows about 5 inches deep in the following manner:

The droppers walk along the rows with a tray in one hand, and place the plants at regular distances, measuring by step, as before mentioned. To place the plant, it should be caught near the top in the right hand, and swung against the straight bank of the furrow with just sufficient force to cause the moist roots to adhere and hold it there. An expert dropper will place the plant at the right height for the coverer so that he need not touch it with his hands. The dropping should be done only as fast as covered, otherwise the plants will wilt and fall into the furrow. This occasions much inconvenience and is a serious injury to the plant. Another important point is to open the furrows only as fast as needed, thus bringing the plants in contact with fresh soil. Covering the plants is a very important matter and only the best hands should be entrusted with this work. It is done with a hoe, by drawing mellow soil up about the plant sufficient to cover the roots, and 4 to 6 inches up the stem, and firming the soil with foot or hoe. In this manner we have planted 10,000 plants in a dry, hot day without losing enough to estimate.

Brief descriptive notes are given for a number of varieties grown at the station.

The following summary is taken from the bulletin:

(1) Transplanting plants at least once is strongly recommended. By this operation they are given a stronger root growth, and productiveness and earliness are enhanced.

(2) Planting in the field can be much facilitated by opening furrows at the proper distance apart for the rows, placing the plants against the straight side of the furrow and covering with a hoe.

(3) Of the so-called "earlies," Early Jersey is considered to be the best variety.

(4) Of the upright, or "tree," varieties, Dwarf Champion is the only one yet tested here which has any particular value. This variety can be grown closely, 3 to 4 feet, and is an excellent sort for the kitchen garden; it also has some promise as a market sort.

(5) Of the large-fruited red sorts, Ignotum is specially recommended, and Haines's No. 64 is about equally good.

(6) Of the large yellow sorts, Golden Queen and Golden Sunrise are the best; we prefer Sunrise.

(7) Among the recent introductions Prelude and Matchless appear to us to be most promising. The first is a weak grower, but decidedly early. Matchless promises well for general crop.

CHEMICAL EXAMINATION OF TOMATOES, W. BOWMAN, PH. D. (pp. 16-18).—The percentages of free acids (calculated as citric acid), glucose, and total solids soluble in water are tabulated for samples of the fruit of 11 varieties. The highest and lowest percentages were as follows: free acids 0.92 and 0.49, glucose 2.71 and 1.59, total solids soluble in water 5.21 and 2.94. The methods of determination are briefly described.

Wisconsin Station, Bulletin No. 26, January, 1891 (pp. 32).

SUGAR-BEET CULTURE IN WISCONSIN, W. A. HENRY, B. AGR., AND F. W. WOLL, M. S.—This gives an account of the investigations of the sugar-beet in Wisconsin in 1890 under the general direction of the U. S. Department of Agriculture. The practicability of producing sugar from beets in Wisconsin, the cost of a beet-sugar factory, the cost of growing a crop of beets, and the place which this industry should occupy in the agriculture of the State are discussed by Director Henry. The experiments in growing sugar-beets in Wisconsin in 1890 are described by Mr. Woll, and tabulated data are given for the yields of beets and sugar, weather, soil, area planted, dates of planting and harvesting, distance apart of beets in the row, hours spent in cultivating the crop, average weight of beets, per cent of sugar, etc. The following summary is taken from the bulletin:

Experiments in the culture of sugar-beets were conducted in our State during the season of 1890 at this experiment station, at five substations (one in each of the following counties, viz., Walworth, Rock, Waukesha, Marquette, St. Croix), and by seventy farmers in different parts of the State.

(1) The six varieties of sugar-beets grown at this station contained from 14.81 to 16.76 per cent of sugar in the juice; the co-efficient of purity ranged from 82.2 to 86.3. About half an acre of each variety was grown, and the yield of washed beets varied with the different varieties from 16 to 26 tons per acre. The estimated yield of sugar varied from 2 to 3½ tons per acre; in a well-managed factory about 80 per cent of this quantity would be recovered as pure granulated sugar.

(2) A careful account of the work done in planting and cultivating the plats of sugar-beets grown showed that it cost from 84 cents to $1.38 to grow a ton of beets. This does not include the cost of harvesting and delivery, which may be considered as about equal to that of growing the crop.

(3) The beet culture at five substations gave beets whose sugar content ranged from 12.81 to 17.14 per cent of sugar in the juice, while the beets would have yielded from 4 tons at the St. Croix County station, where wet, cold weather in June caused the beets to rot and greatly reduced the yield, to nearly 39 tons per acre. The latter heavy yield was estimated from the plats grown at the Waukesha County station.

(4) Seventy farmers in twenty-nine counties of the State sent samples of sugar-beets grown by them to this station for analysis. The results of the analyses showed a very wide range, according to the kind of seed used, the manner of growing, skill of the grower, etc. The lowest of all analyses showed 6.48 per cent and the highest 18.79 per cent of sugar in the juice. The latter result was obtained from beets grown near New Holstein, Calumet County, from which locality also other samples were obtained containing a very high percentage of sugar, indicating that this section may prove particularly well adapted to sugar-beet culture. Of other sections that seem well suited to this crop may be mentioned the counties of Kewaunee, Washington, Rock, Jefferson, Waukesha, Milwaukee, in short the whole eastern and southeastern portion of our State. Upon further trial we hope to report the western portion of the State also adapted to this plant; there seems no cause in soil or climate to prevent good beets being produced there.

(5) Beet associations should be formed and each member should pledge himself to grow from 2 to 3 acres of beets in order to test the capacity and adaptability of the soil in different localities. Common sugar-beet seed may be used for most of the planting [for experiments in the cultivation of beets and for a crop for feeding to stock]. Parts of a few rows should be from genuine imported sugar-beet seed [in order to obtain beets which may be analyzed for their sugar content].

(6) The results of our sugar-beet investigations for the year past are very satisfactory and encourage the belief that Wisconsin is well adapted to sugar-beet culture. Our people are urged to continue their interest in the matter, to move forward with caution, and in no case to enter upon the construction of beet-sugar factories until there is positive assurance that the farmers will grow sufficient beets to keep the factory running for the whole working season, and that the soil of the particular locality is adapted to the crop.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY.

INSECT LIFE, VOL. III, NO. 6, MARCH, 1891 (pp. 251–304, illustrated).—This contains the proceedings of the section on entomology of the Association of American Agricultural Colleges and Experiment Stations at Champaign, Illinois, in November, 1890. A list of the papers presented to the section is given in Experiment Station Record, Vol. II, p. 268. C. M. Weed, D. Sc., publishes in this number a fifth contribution to the knowledge of certain little-known *Aphididæ*, including the sycamore lachnus (*Lachnus platanicola*, Riley), box-elder chaitophorus (*Chaitophorus negundinis*, Thomas), cabbage aphis (*Aphis brassicæ*, L.), willow grove melanoxanthus (*Melanoxanthus salicti*, Harr.), bicolored melanoxanthus (*Melanoxanthus bicolor*, Oestlund), and flocculent melanoxanthus (*Melanoxanthus flocculosus*, n. sp.). For accounts of previous contributions in this series see Experiment Station Record, Vol. I, p. 291, and Vol. II, p. 253.

DIVISION OF STATISTICS.

REPORT NO. 83 (NEW SERIES), APRIL, 1891 (pp. 105–158).—This includes articles on the condition of winter grain, and of farm animals; the permanency of agricultural production; rural co-operative banks in Russia; European crop report for April, 1891; and transportation rates.

The consolidated returns of our county correspondents relative to the present condition of winter wheat over the whole breadth make the general average 96.9, an April figure which has been exceeded but once in 10 years and but three times during the history of crop reporting by this Department. The averages by States are remarkable for their uniformity, showing that the favorable conditions for seeding, germination, and winter growth have been present throughout the whole area. * * * The general average for rye is 95.4.

Losses of farm animals.—The present returns show about an average condition of farm animals as regards healthfulness, though it is below the standard in some districts of partial crop failure. The losses from disease and exposure are estimated, the percentage from each class being reported as, horses 1.7, cattle 3, sheep 4, and swine 8.4. Horses being the most valuable of farm stock, receive most care and attention, and the annual losses are small and vary but little. Mortality among cattle depends largely upon the severity of the season, the heavy losses occurring in the ranch and range regions, where provision for feed and shelter is always inadequate. Last year the loss was heavy, the mildness of the weather in the East

inducing unnecessary exposure, while the rigorous weather of the mountain region was very fatal. The present returns are light, except in the districts of crop failure. Sheep show smaller loss than usual, the present position of the industry warranting more care and attention than this class of farm stock have received during late years. No unusual disease is reported among swine, but losses engendered by neglect and lack of sufficient feed in trans-Mississippi States have swelled the aggregate for the country.

Agricultural production.—Farm labor is not sufficiently effective; its distribution could be more harmonious and profitable. Prices of cereals have sometimes been reduced by oversupply. Cotton, with a product of 22,000,000 bales in 3 years, a quantity greater than the production of 6 years prior to 1860, begins to decline in price. At the same time there is a failure to produce the sugar required, though there is cane land sufficient for an ample supply and beet sugar lands *ad libitum*, without mentioning the possibilities of sorghum. There might be tens of millions of dollars annually coined from various fibers, large extension of fruit growing, and introduction of many economic plants to be made the basis of new industries.

It is not true that the wheat of the world is declining. It is not difficult to prove the existence of 2,300,000,000 bushels as an average, and there is no prospect of decrease. Annual fluctuations, from climatic causes, will produce variation in price, which the distribution of harvests of different climates through the year and increase of international transportation facilities will help to equalize. The United States will continue to produce a surplus for export until the wheat culture of the plains shall have given place to more varied and profitable culture, and increasing numbers of non-agricultural population shall require for bread the entire crop.

It is proper to say that the tendency is towards a better distribution of crops and to higher prices and greater profits.

ABSTRACTS OF REPORTS OF CANADIAN INVESTIGATIONS.

Central Experimental Farm of Canada, Special Bulletin (pp. 49).

THE ESTABLISHMENT OF CHEESE FACTORIES AND CREAMERIES, J. W. ROBERTSON (illustrated).—A brief statement of the ways in which cheese factories and creameries may be carried on by individuals or by companies; the text of a law of the Province of Ontario, approved March 23, 1888, to provide for the incorporation of cheese and butter-manufacturing associations; forms of by-laws, rules, and regulations for joint-stock companies for the manufacture of butter or cheese, and for creameries on the cream-gathering plan and on the centrifugal separator plan; directions for the location and construction of buildings, with plans; lists of apparatus and utensils; notes regarding the duties of cheese makers, milk drawers, butter makers, and cream collectors; general suggestions regarding the management of the creamery business; and a table "showing the number of inches (in depth) of whey to be allowed in milk cans of different sizes, for quantities of milk from 30 to 360 pounds."

Ontario Agricultural College Station, Bulletin No. 58, February 2, 1891 (pp. 10).

EXPERIMENTS WITH SPRING GRAIN.—Notes and tabulated data are given for 10 varieties of barley, 7 of spring wheat, 5 of peas, and 10 of oats, as well as the average yields of barley and oats from seed grown in Ontario and in several countries of Europe, and of two-rowed barley and six-rowed varieties of barley. Herison Bearded wheat, Goanette Black, Houdan Black, Chenailles, Black Etampes (French varieties), and Oderbrucher (German variety) oats are especially commended.

Judging from the experience of the past 2 years the English barleys give, on the whole, the best results, but some fine growing and yielding varieties come from Germany and France. With reference to oats, the French varieties should be placed first, all things considered, although some kinds from Germany do nearly as well.

The average yields obtained from the two-rowed and six-rowed varieties of barley are not far different, nor is there much difference in the average weights of the two classes.

The average returns from the foreign varieties are in a majority of instances superior to those of the old standard varieties.

Ontario Agricultural College Station, Bulletin No. 59, March 14, 1891 (pp. 6).

GREEN FODDER FOR SWINE, T. SHAW.—This is an account of an experiment made "(1) to ascertain whether green fodder used as a food adjunct in summer along with a suitable grain ration, effected a saving in the cost of producing pork, and if so, to what extent; (2) whether a large or a small quantity of the green food used in this way furnished the cheapest ration; and (3) to test the correctness of the theory that some bulky food mixed with a grain ration in feeding swine, secures a more thorough digestion of the grain."

Nine pigs, from 6 to 9 months old at the beginning of the experiment, were divided into three lots of 3 pigs (two barrows and one sow) each, and after a preparatory period of 1 week were fed from June 7 to October 8, 1890, as follows: Lot 1 received all they would eat of a grain mixture consisting of 2 parts by weight of ground peas and 1 part each of ground barley, ground oats, and wheat middlings; lot 2 received about three fourths as much of the grain mixture as lot 1, and a quantity of cut green fodder, "consisting of clover, oats and vetch, corn and millet, as these came in season;" and lot 3 received about one third as much of the grain mixture as lot 1, and about twice as much green fodder as lot 2.

"The aim was to make the quantities of grain used in these two instances exactly two thirds and one third, respectively, of the amount fed to the pigs in lot 1;" but slight variations occurred.

The food consumed, increase in live weight, cost of food, and financial gain or loss per cent are given for each lot. The average gain in live weight and cost of food for each lot are as follows:

	Average gain in live weight per animal.	Percentage of gain.	Cost of food per animal.	Gross cost of food per pound of gain.
	Pounds.	*Per cent.*		*Cents.*
Lot 1	97.3	64.0	$5.07	5.2
Lot 2	74.0	50.0	4.03	5.4
Lot 3	19.7	13.4	2.18	11.07

The cost of food is based on peas at 55 cents per bushel, barley at 50 cents, oats at 35 cents (+8 cents per 100 pounds for grinding), wheat middlings at $15 per ton, and green fodder at $2 per ton. No allowance was made for the value of the manure except as an offset to the cost of the labor.

At the close of the experiment the animals in lot 1 were fat and those in lot 2 prime, while those in lot 3 were not improved in condition.

After the above experiment the pigs were all fed for 40 days on a ration similar to that received by lot 1, to observe any after effects of the feeding of green fodder.

In addition to the observations already stated the following conclusions are given by the author:

A ration of which the major portion consists of green food, as in the case of that fed to the pigs in group 3, will fail to bring them into a marketable condition. Of the rations given to the pigs in the three lots in this experiment the grain ration fed to those in lot 1 has proved in every way the most satisfactory; hence, if feeding a bulky fodder along with grain to pigs is any aid to digestion, it must be given in a less proportion than that used in feeding the pigs in lot 2 in this experiment.

Ontario Agricultural College Station, Bulletin No. 60, March 25, 1891 (pp. 7).

GROWTH AND USES OF RAPE, T. SHAW.—Brief directions are given for the seeding and cultivation of rape (*Brassica campestris*) and for its use as a feeding stuff for sheep; also brief notes on experiments at the station in which rape was used as food for sheep.

ABSTRACTS OF REPORTS ON EUROPEAN INVESTIGATIONS.

The nutritive values of different albuminoid bodies, S. Gabriel (*Journ. f. Landw.*, 37, *pp.* 175–197).—The question whether a difference in the composition of albuminoid bodies is accompanied by a difference in nutritive value is one of importance and one upon which a variety of views have been expressed. Liebig considered the nitrogen as the measure of the food value of albuminoids, their nutritive value increasing with the increase of the proportion of nitrogen. Ritthausen,* on the contrary, measured their value for food by the content of carbon.

The number of experiments on this question is quite limited. Those of Panum † and Heiberg on the one hand, and of Haubner ‡ and Hoffmeister § on the other, are contradictory and lead to no very conclusive results.

Feeding experiments by H. Weiske, ‖ with two sheep, in which the effect of nitrogen from vegetable sources (hay and ground oats) was compared in separate periods with that from an animal source (dried ground fish), led to the conclusion that the nitrogenous substances of ground fish were capable of replacing like quantities of albuminoid materials from vegetable sources.

Likewise, experiments by E. v. Wolff,¶ in which two lots of pigs were fed exactly alike, except that one lot received albuminoids from a vegetable source (peas) and the other a like quantity from an animal source (ground meat), indicated like food values for the albuminoids from the two sources, the gains being the same in the two lots. Owing to certain disturbing influences the results of this trial are not considered as altogether conclusive. The results of experiments by Rutgers ** on himself indicated the same values for albuminoids from animal as from vegetable sources, although this experiment is not considered as entirely reliable, the data being somewhat deficient. Potthaft †† concluded from

* Die Eiweisskörper der Getreidearten, Hülsenfrüchte, u. Oelsamen; Bonn, 1872.

† Virchow-Hirsch, Jahresbericht, 1867.

‡ Gesundheitspflege, 3. Aufl., p. 461.

§ Landw. Versuchs-Stationen, 1874, p. 62.

‖ Journ. f. Landw., 24, p. 265.

¶ Landw. Jahrb., 8 (1879), Sup. 1, p. 223.

** Zeitsch. f. Biologie, 24 (1888), p. 351.

†† Beiträge zur Kenntniss d. Eiweissumsatzes im thierischen Organismus; Diss., Münster, 1887.

experiments on dogs that the albuminoid substances of meat, casein, lentils, and gluten possessed nearly the same values for food, while the albuminoids of lupine were considerably inferior. Gabriel takes exception to the results of this last experiment, particularly to those relating to the albuminoids of lupine.

The following experiments on the nutritive value of certain albuminoids were made by Gabriel, at the suggestion of H. Weiske. The original plan was to feed a mixture of albuminoid materials and starch to geese, but as the geese were nearly dead at the end of two weeks a sheep was used for the trial instead. The experiment was divided into eight periods, from 7 to 13 days each, in all of which the food was the same (500 grams of barley straw, containing 3.25 grams of nitrogen, and 8 grams of salt per day), except the albuminoid materials, which were changed each period. Egg albumin, casein, conglutin (from lupine), rye meal, pea meal, ground meat, and gelatin were each fed with the barley straw for one period, and in quantities furnishing 9 grams of nitrogen per day. In the eighth period the nitrogenous food was replaced by a like amount of starch. The main results, as indicated by the balance of the nitrogen consumed and excreted, are expressed in the following table:

Nitrogen balance.

Period	Fodder.	Nitrogen.						
		In food consumed	Excreted.*a*			Digested.	Stored in body	
			In urine	In fæces	Total		Amount.	Per cent of digested nitrogen.
		Grms	*Grms.*	*Grms*	*Grms.*	*Grms.*	*Grms.*	*Per cent.*
I	Rye and barley straw	*b* 12.24	6.83	4 95	11.78	7.29	0.46	6.31
II	Peas and barley straw	12.24	5 34	5.41	10 75	6 83	1.49	21.82
III	Conglutin and barley straw	12.24	4 88	5.49	10 37	6 75	1.87	27.70
IV	Ground meat and barley straw	12.24	3.65	5 96	9.61	6.28	2.63	41 88
V	Egg albumin and barley straw	12 24	4 39	5 73	10.12	6.51	2.12	32 56
VI	Casein and barley straw	12 24	4 53	5.79	10 32	6 45	1.92	29.77
VII	Gelatin and barley straw	12.24	5.42	5 27	10 69	6 97	1.55	....
VIII	Starch and barley straw *c*	*d* 3 25	2.16	4.40	6 56	*e* 1.15	−3.31	....

a Including undigested food and metabolic products.
b In straw and supplementary food.
c No albuminoid added to the straw.
d In straw.
e Excreted in fæces in excess of amount in food.

The amount of nitrogen stored with the three albuminoid preparations, egg albumin, casein, and conglutin, varied somewhat and was in the order named. The results with the albuminoid bodies contained in the different feeding stuffs differed much more widely. The smallest amount of nitrogen laid on was with the rye; that with ground meat was the largest; and that with peas was about midway between the two. In general the amount of nitrogen stored in the body was inversely proportional to the amount digested.

During the 12 days when gelatin was fed no change was observed in the animal. Experiments by Voit* have shown that gelatinous sub-

* Zeitsch. f. Biologie, 8, pp. 297–387.

stances can not entirely fill the place of the albuminoids, but like fat and carbohydrates, act as albuminoid conservers, so that an animal may be kept on a food deficient in albumin when gelatinous substances are added to it. In an experiment by Weiske, Schrodt, and v. Dangel* on two sheep, the addition of 53 grams of gelatinous substances to a ration consisting of 500 grams hay, 200 grams starch, and 50 grams sugar, increased the amount of nitrogen stored in the body in No. 1 from 0.279 gram daily to 1.98 grams, and in No. 2 from 0.27 to 0.68 gram; while the addition of an equivalent amount of peas in place of the gelatinous substances increased the nitrogen stored in the body with No. 1 to 1.668, and with No. 2 to 2.427 grams of nitrogen per day.

The results for period 7 of the present experiment showed how extensive the action of gelatin in economizing the albuminoids may be, for with its aid the ration of barley straw, containing only 3.25 grams of nitrogen, was sufficient to maintain an animal weighing over 100 pounds, and even enable it to lay on a small amount of nitrogen (1.55 grams per day). Since gelatin is not assimilable this 1.55 grams of nitrogen must have come entirely from the straw; and since this amount is 48 per cent of the total nitrogen in the daily ration of straw (3.25 grams) the indications are that the gelatin prevented the destruction of the digestible albuminoids of the straw quite completely, causing them instead to be stored in the body.

The object of the last period's feeding (straw and starch) was to furnish a basis for comparing the effects of the albuminoid materials. By feeding a nitrogen-free substance (starch) in place of the materials containing protein, a factor for the effect of the straw was obtained, which, deducted from the results of each previous period, indicated more closely the effect due to the supplementary food. The animal refused the food after 2 days and the feeding was continued with another sheep. As the nitrogen voided in the fæces was exactly the same, and that in the urine nearly the same as in the case of the first sheep, the results were considered as reliable for comparisons. The fæces in this period, contrary to those of all the other periods, were strongly acid, and gave a strong reaction for starch. This agrees with the results of Haubner and others, which have shown that while large quantities of starch were thoroughly digested when fed in a ration with protein substances, they were not completely digested when the protein was diminished beyond a certain limit.

The results of this experiment do not support the view that either the nitrogen content (Liebig's theory) or the carbon content (Ritthausen's theory) of albuminoid materials can be considered as indicative of their nutritive value, nor do they indicate any apparent relation between the chemical composition of these bodies and their value for food. Taking the observed results in this trial as the measure of the values for increasing the store of nitrogen in the body, conglutin, which differs

* Zeitsch. f. Biologie, 15, p. 261.

most in composition from the other protein substances tested, very nearly approached the albumin and casein in value. The low value of the albuminoids of the rye compared with those of the other feeding stuffs is noticeable. Ground meat was by far the most favorable to the laying on of flesh. While in Wolff's experiments with pigs, referred to above, no difference in nutritive value was noticeable between the albuminoids of peas and of ground meat, in this experiment there was a very noticeable difference in favor of the ground meat.*

The table of results shows that the three animal albuminoid substances (ground meat, albumin, and casein) in general gave a higher nutritive effect than the three from vegetable sources (rye, peas, and conglutin), though the conglutin very nearly approached the casein in value. The author considers that other experiments are necessary before a general rule regarding this point can be laid down.

[A difficulty with experiments of this class, and one which for aught we know may be serious, is that the effects of the bodily condition of the animal on the storing of protein and fat in the body, and of the nutrients of the concentrated foods of the several periods other than protein are not determined, and can not be without the respiration apparatus. A more nearly complete balance of income and outgo of material is necessary for estimating the effects of the several albuminoids. Furthermore, to make the generalizations entirely reliable, experiments with several animals are needed in order to eliminate the effects of individuality.—W. O. A.]

Do the organic acids contained in feeding stuffs possess an action similar to the carbohydrates in conserving the albuminoids? H. Weiske and E. Flechsig, reported by H. Weiske (*Journ. f. Landw.*, 37, *pp.* 199–234).—The nitrogen-free extract of feeding stuffs is made up of numerous substances, among them starch, sugar, gums, mucilages, pectin substances, lignin, and organic acids. Of these the first five are considered by the author to be of practically the same physiological value, so far as they are digestible. Lignin, on the contrary, being almost wholly indigestible, is believed to possess no value as food. Organic acids occur in most feeding stuffs in small quantities only, and combined with bases, though in some materials, as for instance silage, brewers' grains, etc., they are often present in considerable quantities and in part uncombined. Acetic and lactic acids are of especial importance in this connection, as under certain conditions these two acids are consumed by animals in considerable quantities. Our knowledge regarding the value of these acids for food is very deficient. We know from the investigations of Wöhler, Lehmann, and others that organic salts which are used in the animal organism are changed there into carbonates and are excreted as such in the urine, imparting to it an alkaline reaction. Under normal conditions, then, the greater part of these acids consumed is

* See, however, discussion between Gabriel and Pfeiffer, Jour. f. Landw. 38, pp. 463 and 469.

oxidized (burned) in the body, and this leads the author to suggest that they may possess certain fuel values, by their combustion preventing other materials from consumption.

It is known that starch and all digestible carbohydrates possess a high value as food, and that so far as they are not changed into fat within the organism and as such stored in the body, they are burned to carbonic acid and water, thus decreasing the destruction of the albuminoids and diminishing the loss of fat from the body.

To determine whether the acetic and lactic acids occurring in certain foods exert an action similar to that of carbohydrates in conserving the albuminoids the following experiments were made: A rabbit was placed in a small zinc stall, with arrangements for collecting the solid and liquid excreta. The food consisted in the first period of 15 grams ground meat (containing 1.94 grams nitrogen and 1.8 grams fat), 30 grams starch, 10 grams sugar, 5 grams nutshells, 0.5 gram ash of hay, and 0.2 gram salt per day, with water *ad libitum*. The nutritive ratio of this ration was 1:3.7. The ingredients were mixed with hot water to a homogeneous plastic mass, kneaded, dried, and the mass broken into pieces the size of a pea, for feeding. By this means it was possible to feed the whole ration without waste.

For 10 days, following a preparatory period of 8 days, the urine was carefully collected and the nitrogen in the same determined. The live weight remained quite constant at 2,390 grams. The average excretion of nitrogen in the urine was 1.46 grams per day. In the second period, immediately following the first, 10 grams of starch were replaced by 10 grams of acetic acid in form of calcium acetate for 1 day and of sodium acetate for 2 days; but this food being refused by the animal, 18 grams of calcium lactate (=10 grams lactic acid) were substituted for 4 days. At the end of this time it was apparent that the acid could not be successfully fed for any length of time, and the food was changed. The live weight had fallen to 2,132 grams. The nitrogen in the urine averaged per day for the first 3 days 1.96 grams, and for the last 3, 1.87 grams, or 1.92 grams for the period. The excretion of nitrogen had, then, increased about 30 per cent over that of the first period, although the food was not all eaten and therefore considerably less nitrogen was consumed. The urine had a strong alkaline reaction and was rich in carbonates. Neither acetic nor lactic acid could be detected at any time, and it is believed they were completely burned to carbonic acid. The author concludes that the addition to the food of 4.3 grams of acetic or lactic acid per 1,000 grams live weight did not conserve the albuminoids of the body, but on the contrary probably increased the albuminoid metabolism.

The food in the third period was the same as in the second, and in the fourth only differed by a reduction of the starch from 30 to 20 grams per day. The feeding of the latter ration was accompanied by a falling off of 65 grams in live weight in 4 days, and an increase of the excretion of nitrogen in the urine to 1.71 grams per day (period 1, 1.46

grams nitrogen per day; period 2, 1.92 grams). The fact that the amount of nitrogen in the urine was not as large in period 4 as in period 2 (when acid was added to the food), indicates, in the opinion of the author, that the increased breaking down of albuminoids of the body and excretion of the nitrogen during period 2 was not due exclusively to the reduction of the starch from 30 to 20 grams, but in part to the addition of the acetic and lactic acid.

A second trial was made with a rabbit weighing 3,500 grams. In the first period 25 grams pea-nut cake (previously treated with ether and with malt to remove part of the fat and carbohydrates), 43 grams starch, 12 grams sugar, 5 grams nutshells, 0.5 gram hay ash, and 0.2 gram of salt were fed per day. The ration contained 2.65 grams of nitrogen from vegetable source. The excretion of nitrogen in the urine averaged during 12 days 2.56 grams per day. In the second period, 9 grams calcium lactate (5 grams lactic acid) were added to the ration without reducing the starch. This was eaten readily after a few days. The live weight remained nearly constant during this period. The average daily excretion of nitrogen during the 6 days was 2.52 grams. The addition of 2.2 grams of lactic acid per 1,000 grams live weight had, therefore, caused no increase in the nitrogen metabolism of the body, neither had it apparently prevented this and so conserved the albuminoids. The author concludes from the results with rabbits that the addition of large quantities of lactic or acetic acid (4.3 grams per 1,000 grams live weight) in the form of salts, to a narrow ration (1:3.7) caused an increase of the nitrogen metabolism of the body instead of conserving the albuminoids as the carbohydrates do; while the addition of smaller quantities of lactic acid (2.2 grams per 1,000 grams live weight) tended rather to decrease than to increase the albuminoid metabolism.

A trial was then made with a sheep weighing 42.5 kg., which received during the first period 450 grams hay, 75 grams starch, 30 grams cane sugar, 200 grams pea-nut cake, and 8 grams salt daily. In the second period there were added to the ration 60 grams of lactic acid in the form of calcium lactate, which was readily eaten, and this ration was fed for 10 days. The results for the two periods follow:

Averages per day.

Period.	Water drank.	Urine.		Nitrogen.	
		Total amount.	Nitrogen in.	Digested.	Stored in the body.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*
First	1,609	1,170.1	17.56	18.06	0.50
Second (acid added)	2,091	1,451.3	15.60	17.83	2.23

Somewhat smaller quantities of protein, fat, and crude fiber were digested in the second than in the first period, and the increased amount of nitrogen-free extract digested was not equal to the amount of lactic acid added. The addition of 60 grams of lactic acid to the food (1.4

grams lactic acid per kilogram live weight) was accompanied by an increased storage of albuminoid materials in the body, assumed by the author to be due to its decreasing the nitrogen metabolism of the body.

Increasing the lactic acid to 120 and 180 grams per day did not increase the amount of nitrogen stored in the body.

To study the action of acetic acid the same sheep was fed the same basal ration as before, to which 60 grams of acetic acid in the form of sodium acetate were added daily. After this the feeding was continued with the basal ration. The average daily excretion of nitrogen in the urine was 16.54 grams previous to the feeding of acetic acid, 17.04 grams during the acid feeding, and 16.50 grams after.

The effects of the addition of like quantities of lactic acid in the form of calcium lactate, and acetic acid in the form of sodium acetate to the same normal ration were very different. While the former (lactic acid) diminished the nitrogen metabolism and increased the storage of nitrogen, the latter was diuretic in its action and increased the nitrogen metabolism of the body.

The determination of free fatty acids in feeding stuffs, G. Loges and C. Claessen (*Landw. Versuchs-Stationen*, 38, *p.* 314–316).—This is a comparison of four methods of determining the free fatty acids in feeding stuffs, on 12 samples of rice meal, cotton-seed meal, wheat bran, rye bran, and pea-nut, rape, linseed, sesame, cocoa, palm nut, hemp, and sunflower cakes.

The methods of treatment were as follows:

(1) Sample dried for 3 hours, extracted with ether, the ether extract dried at 100° C. for 2 hours, the residue dissolved in 25 c. c. ether, 25 c. c. alcohol added, and the solution titrated with tenth-normal soda solution.

(2) Sample dried for 3 hours, extracted with ether, 25 c. c. of alcohol added to the ether extract, without previous drying, and the solution titrated with soda solution as above.

(3) Sample extracted without previous drying, and the ether extract treated as in 2.

(4) Sample digested with ether at ordinary temperature (10 grams substance and 100 c. c. ether) for 3 hours with frequent shaking, and an aliquot part of the filtrate treated as in 2.

Alcoholic soda solution and phenolphthalein were used for all the titrations, and the results were calculated for oleic acid.

The tables of results show: (*a*) Method No. 1 in almost all cases gave too low results; in extreme cases it indicated only about one half of the acid really present. (*b*) In some materials the low results seemed to be due to the volatilization of part of the acids by drying the substance previous to extraction with ether (indicated by comparison of results by 2 and 3). In other materials no loss seemed to be traceable to this cause, but loss seemed to come from the volatilization of the acids in drying the ether extract (indicated by comparing results by methods 1 and 2). This variation in the behavior of different materials is believed to be due to differences in their cellular constitution, one substance allowing the acids to escape from its cells in drying much more readily than another. (*c*) The results by methods 3 and 4 agreed quite

closely in most cases. The results where the substance was not dried before extraction (method 3) were in general somewhat higher than those where it was previously dried (method 2); in one case this difference amounted to nearly 3 per cent of oleic acid.

The experiments indicate, in general, that the estimation of free fatty acids in the dried ether extract from materials previously dried does not give a reliable indication of the character of the fat. The absolute content of free fatty acids can only be determined according to methods 3 or 4. A combination of these methods and method 1 may be of value as indicating (by the difference between the results of 1 and 3 or 4) the content of volatile fatty acids, which largely influence the smell, taste, and general effect of the food upon the animal. Since they are largely products of decomposition by fungous or bacterial growth, their determination furnishes a means for judging of the degree to which a feeding stuff has spoiled. The so-found volatile acids calculated to oleic acid should be recalculated for some volatile fatty acid of lower molecular weight, as, for instance, butyric acid. Otherwise in some cases a larger amount of fatty acids might be found than of total ether extract, as was the case in an analysis of pea-nut meal cited by the authors.

Xylose, or wood sugar (*Landw. Versuchs-Stationen*, 38, *p*. 322).—In the section for agricultural chemistry and experimentation at the meeting of German naturalists, September, 1890, Professor B. Tollens described the preparation, properties, and reactions of xylose, and its occurrence in wood and numerous feeding stuffs. He urged the desirability of taking the xylose into account in the examination of feeding stuffs, and of determining its nutritive value.

Dr. F. Lehmann (Göttingen Experiment Station) stated that he planned to make experiments to determine the digestibility of the gums, the wood gum (giving xylose by inversion) among others. Large quantities of substances giving the furfurol reaction, a characteristic of xylose, arabinose, and substances yielding these sugars, were recognized in dried excrement, indicating that these substances pass through the animal without being digested. Experiments in feeding pea-nut cake and woody substance previously treated with sodium hydrate solution (which extracts the wood gum, yielding xylose by inversion with acid) showed that the crude cellulose was rendered much more digestible by the removal of this wood gum.

The gravimetric determination of pentaglucoses in vegetable materials, B. Tollens and G. de Chalmot (*Ber. d. d. chem. Gesell.*, 24, *p*. 694).—This is a modification of the method recently described by Tollens and Günther.* The material to be examined is distilled in a bath of Rose's metal with HCl of 1.06 specific gravity, allowing acid of the same strength to replace that distilled over. The furfurol in the distillate is determined not by titration, but by precipitation with phenyl-hydrazin acetate. The distillate is neutralized with sodium carbonate, slightly

* Ber. d. d. chem. Gesell., 23, p. 1751.

acidulated with acetic acid, and acetate of phenyl-hydrazin added. The precipitated furfurol-hydrazon is collected in a Soxhlet asbestos filtering tube and dried at 50 to 60° C. in a partial vacuum, rarefied air, freed from moisture, being drawn over the precipitate by means of a suction pump. The weighed furfurol-hydrazon is calculated to furfurol, using the factor 0.516 and making a constant correction of 0.0252 gram for the furfurol remaining unprecipitated in the solution. In a large number of determinations the average yield of furfurol from arabinose has been 48.72 per cent, and from xylose 56.25 per cent. In calculating to pentaglucoses in general the furfurol is multiplied by 52.2.

The difference between parallel determinations in the same material is said to be not over 0.6 per cent of furfurol. The authors believe the gravimetric method to be more accurate, safer, and no more difficult of execution than that by titration.

Investigations by Tollens, E. Schulze and Steiger,* and Stone† have shown the occurrence of the pentaglucoses in vegetable materials to be widespread, and often in considerable quantities.

The nature of the root tubercles of leguminous plants.—A review by H. W. Conn.—For a long time it has been known that when certain plants of the family Leguminosæ are grown under normal conditions there are formed on their roots small swellings known as root tubercles. Their origin and significance has not been understood, but within the last 3 years it has been quite definitely shown that they are intimately associated with the power possessed by these plants of accumulating nitrogen from the atmosphere. The great interest of this fact has led to a further study of the tubercles, and through the work of Beyerinck, Prazmowski, Frank, Laurent, and others we have obtained many facts in regard to them. The object of the present paper is to review recent investigations in regard to their origin and structure. The discussion of their functions, especially in connection with the acquisition of atmospheric nitrogen, is reserved for a later issue.

Earlier observations.—At first the tubercles were supposed to be insect galls. This idea was soon abandoned, and they were then regarded as buds of incomplete plants, or as rudimentary roots. In 1866 Woronin‡ found in them numerous minute bodies which bore some resemblance to bacteria. They were sometimes rod-shaped, but often slightly forked into T or Y-shaped bodies. On account of this irregularity in shape the discoverer was unable to say whether they were true bacteria or not. He therefore called them bacteroids, and regarded them as the cause of the tubercles. In 1874 Erickson § found that in the early stages of the development of the tubercle it was filled with long, branching threads resembling the mycelium of fungi, and to these hyphæ he attributed the

* Ber. d. d. chem. Gesell., 23, p. 3110.

† *Ibid.*, 33, p. 3791.

‡ Mém. Acad. imp. des Sciences de St.-Pétersbourg, t. x, 1866, No. 6.

§ Studier öfver Leguminosernas Rotknölar, Lund.

formation of the tubercles. In later stages of the growth of the tubercles he found bacteroids, but was unable to determine whether they had any connection with the hyphæ or not.

Meantime other experimenters had been led to quite different conclusions. Brunchorst,* Tschirch,† and Van Tieghem and Doulliot ‡ concluded that the tubercles were normal products of the plants and had no connection with any infection from without. The hyphæ and bacteroids were always found, but were regarded as peculiar conditions assumed by the protoplasm of the root cells, rather than as distinct organisms.

Results of later work.—New and more careful experiments within the past 3 years have furnished strong indications that the tubercles are not normal products, but are produced in the roots as a result of infection from without. Hellreigel § found, as the result of a long series of experiments, that when pea plants were grown in sterilized soils, as a rule no tubercles were formed; but when the plants were watered with soil infusions, made by allowing water to act upon soil in which peas had been grown, the tubercles appeared in abundance. If the soil infusion was sterilized by boiling before it was put upon the plants no tubercles appeared. These experiments were thought to prove that the tubercles were really caused by living organisms in the soil infusion, which were killed by heat. The tubercles could not, therefore, be regarded as normal products of the roots, but were certainly infections from the soil. In a series of researches, undertaken with the assistance of Wilfarth,‖ these results were thoroughly confirmed. Hellriegel's researches were, however, undertaken chieflyto determine the relation of the tubercles to the power of assimilating nitrogen, and did not, therefore, deal to any extent with the nature of the tubercles beyond proving them to be infectious.

The observations of Hellriegel were soon confirmed by Ward,¶ who also insisted on the infectious nature of the tubercles and more carefully studied their formation. He found that the hyphæ described by Erickson appear early in the development of the tubercles, and after growing for a while give rise, by budding, to the bacteroids. The plant thus concerned in the formation of the tubercle he regarded as one of the low fungi whose parasitic habits had destroyed its power of producing spores.

In 1888 Beyerinck ** reached a different conclusion as to the nature of this organism. He extended the study from peas, on which most of the previous work had been done, to a large number of leguminous

* Vorläuf. Mitt.; Ber. d. bot. Gesell., 1885.

† *Ibid.*, 1887.

‡ Bull. de la Soc. bot. de France, 35 (1888).

§ Tagebl. d. 59. Versamml. deut. Naturf. u. Aerzte in Berlin, 1886.

‖ Beilageheft zu d. Zeits. d. Ver. f. d. Rübenzucker-Industrie d. d. R., 1888.

¶ Phil. Trans. Roy. Soc., London, Vol. 178, 1887.

** Bot. Ztg., Bd. 46, 1888.

plants, and found that the formation of tubercles was very general in this family. He found further, that there were bacteria associated with all tubercles, and although the bacteria differed somewhat in the tubercles of different species of plants, still there were certain constant characteristics to be seen in them all. He therefore regarded the tubercles as the result of the action of bacteria and gave to the organism producing the tubercles the name of *Bacillus radicicola.* Beyerinck regarded the so-called bacteroids of Woronin as degenerate forms of the bacteria—involution forms, which appeared only after the bacteria had lost their vigor. In a later investigation, after isolating the bacteria and keeping them in pure cultures for many months, he was able to produce the tubercles at will by inoculating soils in which his plants were grown with the pure cultures of the organisms.

In 1890 Prazmowski* published a detailed account of an extended series of researches which he had been carrying on for several years. He confirmed all of Hellriegel's results, showing conclusively that if sufficient precautions were taken to sterilize the soil in which leguminous plants were grown, no tubercles were ever produced; but that they could be produced at will by the addition of soil infusion as above described. He further showed that the tubercles grow in plants developing both in the light and in the dark, but are larger in plants growing in the light; that they only appear in healthy plants; that they are very few in plants growing in well-washed sand; that if plants growing in sterilized soil be watered with brook or river water, tubercles occasionally develop, but never in abundance; and that the infection of the roots occurs early in the germination of the plant and can not take place in the older roots. All of these results indicated, of course, that the tubercles were produced by certain micro-organisms which are present in abundance in soils in which leguminous plants have grown, but are not very abundant elsewhere.

Turning to the study of the microscopic appearance, he found the hyphæ abundant in the young tubercles, and the bacteroids in the older ones, as previous observers had done. Guided by the work of Beyerinck he found bacteria in abundance, and by causing them to grow under the microscope thought he could verify the connection between the bacteria and the bacteroids which had been described by Beyerinck. Prazmowski then isolated the bacterium and made a careful study of its characteristics. He prefers to call it *Bacterium* (instead of *Bacillus*) *radicicola,* since it always appears as a short rod and never in the form of a slender thread. He found several varieties of the organism associated with different species of leguminous plants. In all of his artificial cultures the organism remained a typical bacterium, never assuming the bacteroid forms which appear in the tubercles. From this he concluded that the degeneration or involution forms appear only under the influence of the root cells of the host plant.

* Landw. Versuchs-Stationen, 37, p. 161.

According to the investigations of Prazmowski the development and growth of the tubercles are as follows: *Bacterium radicicola* lives normally in the earth and collects in numbers on the outside of the roots of various legumes. Some of the organisms succeed in forcing their way into the tissues of the young roots, though they are not able to pierce the older roots. For awhile they may remain in the root as free bacteria, but the plant plasma seems to exert an injurious influence upon them, for very soon a thin membrane is formed around the bacteria masses, inclosing them like a pouch. Prazmowski thinks that this membrane is a product of the bacteria themselves, formed for the purpose of protecting them from the injurious action of the plant tissue. The bacteria which do not succeed in getting into one of these pouches soon cease to grow and degenerate into irregular forms like the bacteroids which appear later in greater numbers. The bulk of the bacteria, however, become inclosed in the membrane, after which they continue their growth with much vigor. The pouches begin to grow into thread-like masses, and these make their way among the cells of the root. The thread branches more or less as it lengthens and its various filaments grow through and between the cells, soon permeating the root with a fine, branching filament, which looks much like the mycelium of a mold. It was this bacteria pouch which was first seen by Erickson, and which previous observers regarded as the hypha of some low fungus. Instead of being a mycelium growth of a mold the thread is nothing more than a large, branching colony of bacteria inclosed in a thin membrane.

The growth of this colony of bacteria among the cells of the root stimulates these cells to an unusual growth. They multiply more rapidly than usual, and thus soon produce a swelling on the root which is the beginning of the tubercle. While this rapid multiplication of root cells is going on, the bacteria pouch continues to grow, and swells out into rounded vesicles within the cells which lie at the center of the forming tubercle until most of them become filled with these expanded portions of the bacteria thread. Meantime the root cells of the plant have been rapidly growing, and form around the cells containing the bacteria several layers of smaller cells, which develop into a hard, corky covering forming a coat around the tubercle. This seems to be impervious to the bacteria thread, and confines the bacteria within its limits.

The bacteria colony now undergoes a change. Although Prazmowski has not been able to follow the details of the process, it is thought that the vesicles in the central cells swell until the membrane covering the bacteria is so thin that it bursts, and the bacteria are themselves extruded into the plasma of the root cells. At all events the vesicles disappear and there appears in their place what is called the bacteroid tissue. His interpretation of this is that the vesicles burst and the bacteria coming into the cell plasma are immediately checked in their

growth by the injurious influence of this plasma and begin to undergo involution changes. Instead of multiplying in the normal manner, they assume various abnormal forms which have no further power of growth. They become, in short, the bacteroids which have been found by so many observers, filling the central cells of the tubercle. The bacteria retain their power of growth only so long as they remain in the protecting covering of the membrane.

The tubercle by this time is pretty well formed. The outer cells have undergone quite an extended growth and differentiation, so that the tubercle is really a structure of a rather high grade of plant tissue. The tubercle itself is thus really a growth of the root cells of the plant and not a growth of bacteria. But in the center of this mass of plant tissue are a large number of cells, which are completely filled with the so-called bacteroids. These bacteroids give to the tubercle at this stage a flesh-red color. Some of these central cells are so completely filled with them that nothing else can be seen, while others may show the nucleus. In others spaces begin to appear in the body of the cell. The appearance of the spaces marks a new stage in the history of the tubercle, and indicates that the bacteroids are beginning to be absorbed by the plant. The cell plasma soon assumes a network structure, and from this time the bacteroids entirely cease their activities and begin to disappear rapidly. After a little they are completely absorbed by the substance of the plant and the tubercles are left as empty pouches. The tubercles have now changed their appearance again and assume a somewhat grayish-green color.

This practically ends the history of the tubercle. In most cases some of the bacteria seem to remain within their original membrane, and therefore are still capable of growing. These may now set up a secondary growth, but it amounts to little, for by this time the plant has usually blossomed, ripened its seeds, and the root is beginning to die. The tubercle is immediately attacked by the putrefactive bacteria in the soil and becomes decomposed.

Frank has also published an extended series of observations upon the same subject.* While he differs from Prazmowski in some important particulars, his later results are, on the whole, a good confirmation of those of the latter writer. He, too, finds the tubercles produced as infections by some organisms in the soil, and the organism to which he attributes them is described by him as a micrococcus or short rod, and is very probably the same as that studied by Prazmowski. His explanation of the hyphæ and the bacteroids is different from the one just noticed. The hyphæ he finds filled with bacteria, as does Prazmowski, but he regards the membrane that surrounds them as a product of the root cells rather than of the bacteria. He thinks that the root cells produce these peculiar threadlike forms in which the bacteria multiply, and that by means of the threads the bacteria are conducted into the

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* Landw. Jahr., Bd. 17, 1888, pp. 421–552, and 19, 1890, pp. 523–640.

inner cells of the root to produce the infections there. He therefore calls them "infection threads."

The first essential point in which his theory differs from that of Prazmowski is, thus, in regarding the filaments as products of the root cells instead of the bacteria. He thinks that in some cases the infection occurs without the development of the filaments. After the infection the cells of the root are stimulated into growth to form the tubercle, as already described, and bacteroids appear in the central cells. Frank, however, regards the bacteroids as peculiar formations of the plant tissue and not as distinct organisms or degenerate bacteria. According to him the presence of the bacteria produces abnormal changes in the plasma of the root cells, causing it to become separated into numerous irregular masses which contain the bacteria inside of them. These masses are the bacteroids which fill the central cells. They are subsequently absorbed by the plant in the manner described by Prazmowski.

The most recent work on the subject is that of Laurent.* In a series of experiments performed at the Pasteur Institute in Paris he made new observations as to the relation of the tubercles to organisms in the soil. In his experiments he successfully made use of water cultures, and succeeded in obtaining tubercles in abundance by direct inoculation. His method of inoculation was a new one. He stuck the end of a needle into the tubercle of a leguminous plant and then pricked the young root of the plant growing in his water culture with the needle. This sort of inoculation was in all cases followed by the growth of a tubercle at the point of inoculation. The effect was not wholly confined to this point, however, but was commonly somewhat diffuse, a fact easily explained by the diffusion of the organism through the water. Laurent found that he could produce the tubercles on the root of the pea plant by inoculating it from tubercles in any one of thirty-six different species of leguminous plants, although not all species would produce them in equal numbers. These and further observations convinced him that there are a large number of varieties of the organisms associated with the different leguminous plants, and that these varieties may live side by side in the soil. They are not, however, present in soil in great abundance unless leguminous plants have been previously growing there. Laurent shows that the ordinary soil bacteria have no power to produce tubercles.

In these results the work of Laurent confirms that of Prazmowski and Frank; but in his study of the organism itself Laurent reaches a different conclusion. In his studies of pure cultures of the tubercle organism he finds that in gelatin the organisms spontaneously assume, by a sort of budding, the irregular forms which have been called bacteroids. The bacteroids are therefore not a degenerate form of the bacteria, resulting from the deleterious action of the plant tissue, nor are they aggregations of the root plasma, but they are normal forms of

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*An. d. l'Inst. Pasteur, 1891, No. 2.

the organism. He further asserts that the bacteroids found in the tissue of the tubercles arise, not by a degeneration, but by a normal process of budding from the hyphæ. The hyphæ themselves he looks upon as filamentous growths of the organism, and not as pouches filled with bacteria nor as products of the root cells. Now, since bacteria always multiply by division and never by budding, it is plain that if these observations of Laurent are correct, the organisms in question can not be called bacteria. Laurent, therefore, like Ward and other earlier investigators, affirms that the organism is really a low fungus, that the hypha is a sort of mycelium of some low fungoid plant, and that the bacteroids are buds from it. It seems to be related to the yeasts in its method of growth, and Laurent regards it as intermediate between the yeasts and the filamentous fungi. He accepts the name formerly suggested by Frank, *Rhizobium leguminosarum*.

Comparison of views.—Summary.—The three views thus outlined give in substance our present knowledge of the origin and structure of these tubercles. It may seem strange that there should be such a difference of opinion on mere matters of fact, but the differences are explained by the difficulties of observation. The tubercles grow naturally under ground, Laurent alone having had much success with water culture. They are opaque, and can therefore only be studied by tearing them to pieces or by cutting sections of them. The organisms which produce changes are microscopic, and it is therefore impossible to watch their action on the root cells. The only method of observation is by examining a large number of tubercles in different stages of growth, and in this way important points are sure to be missed. Differences in results of observation as wide as above sketched are, therefore, not surprising.

Taking all of these observations together we may conclude that our present knowledge of the nature of these tubercles is somewhat as follows: They are not normal products of the plant, but are in all cases produced by infection from some organisms which exist in the soil and attach themselves to the young root. Their presence in the root tissue stimulates the root cells to active growth and a mass of new tissue is formed around the growing organisms. This tissue forms the tubercle and confines the infectious action within narrow limits. The tubercle is thus a sort of gall. The study of the development of this gall shows three somewhat distinct stages. First there appears a branching filament which grows among the cells of the root and which soon stimulates an active growth of the root cells. A little later, after the tubercle is formed, the central cells become filled with the bodies called bacteroids. Lastly the bacteroids of the central cells are absorbed by the plant and the tubercle becomes empty. These facts are agreed upon by all.

In regard to the significance of these facts there are three distinct opinions. The first is that of Prazmowski, who calls the organism which produces the infection a bacterium, and claims that the branch-

ing filaments are simply colonies of bacteria inclosed in a membrane of their own manufacture, for their protection against the injurious action of the plant tissue. The filaments swell with the multiplication of the bacteria until they burst. The bacteria then coming into contact with the plant tissue and no longer being able to grow, owing to an injurious influence of the plant plasma upon them, degenerate into the bacteroids. They are subsequently absorbed by the plant and incorporated into the substance, serving therefore as food.

The view held by Frank differs from this essentially in its explanation of the filaments and bacteroids. The filaments are said to be a mixture of plant protoplasm and bacteria. They are produced by the plant and serve to conduct the infectious matter into the midst of the root. The bacteroids are also products of the plant plasma, and not distinct organisms. Their absorption does not, therefore, especially help the plant.

The third view, that of Ward and Laurent, regards the infecting organism not as a bacterium, but as a low fungus, somewhat closely related to the yeasts. The filament is really a mycelial growth of the organism, and the bacteroids arise from it by budding. The bacteroids are thus distinct organisms—not degenerate forms, but normal growths.

None of these views would regard the tubercle organisms as true parasites on the plant since the plant is not injured by them, but is probably directly benefited. The association is rather to be regarded as an instance of symbiosis, an association of two organisms together in such a way that each receives benefit from the other. The plant is probably benefited in gaining nitrogen, and the infecting organism is benefited in gaining a brood pouch for its development.

EXPERIMENT STATION NOTES.

CALIFORNIA STATION.—The interest in ramie and other textile plants still continues in California, and the station is doing what it can to supply the demand for plants. The State Agricultural Society has recently been furnished with stock for experimental plats in the State capitol grounds at Sacramento. The garden of California wild plants established at Berkeley in February, under the supervision of Professor E. L. Greene, is filling up with rare species. In the garden of economic plants a new plantation has been devoted to various species of *vitis*.

At the newly established station for Southern California, near Pomona, about 12 acres have been planted in trees and vines, nursery plants, cotton, clovers, grasses, sorghum, sugar-beets, etc. The orchard includes 200 orange, lemon, lime, and citron-trees, besides olives, figs, pomegranates, guavas, and other semi-tropical fruits. At the San Joaquin Valley station near Tulare a special feature of the work has been an attempt to drain and "leach out" a piece of alkali land in very bad condition. This is being done in a simple and efficient way, within the reach of every farmer in the alkali districts of California. A pit like a well was first dug and "boxed" with rough lumber. This pit reaches down to the gravel underdrainage, a cheap wooden drain placed 2 feet under the surface leading into it. The surface has been plowed to break the crust, and after the application of land plaster, water is being used on the plat to wash out the alkali. The details of this experiment will be published at some future time.

MASSACHUSETTS HATCH STATION.—Soil tests with fertilizers carried on in 1890 in 10 counties of the State have given interesting results, which will be published in Bulletin No. 14 of the station.

The station barn was destroyed by fire April 4.

MISSISSIPPI STATION.—B. D. Halsted, D. Sc., of the New Jersey College Station, has undertaken special work for the Mississippi Station on the tomato blight, which has been quite prevalent in the Southern States during the past three years.

NEVADA STATION.—R. H. McDowell, B. S., assistant agriculturist of the Colorado Station, has been appointed agriculturist of the Nevada Station.

NORTH CAROLINA STATION.—This station is collecting data with a view to establishing a laboratory standard of quality for the more important field and garden seeds. The co-operation of other stations in this work is desired. Samples of seed will be distributed to the stations for this purpose. It is also desired that the sprouting pan used at this station shall be tested at other stations.

OHIO STATION.—R. H. Warder of North Bend, has been appointed a member of the board of control, vice J. L. McIlvaine. Freda Detmers, B. S., has been appointed acting botanist, and John A. Alwood, foreman of the farm, has resigned. F. M. Webster, special agent of the Division of Entomology of the United States Department of Agriculture, has severed his connection with the Indiana Station, and will act as consulting entomologist to the Ohio Station.

The legislature of Ohio has passed an act opening the way for the removal of the station to a new location in that county of the State which shall make the most

advantageous provisions for land and other equipment for the station. The counties are authorized to vote a special tax for this purpose. The principal reasons for the removal of the station are that the soil of the farm of the State University now used by the station is so fertile that the results of field experiments there can not be taken as reliable indications of what may be expected on the average soils of the State; and, secondly, the rapid growth of the city of Columbus around this farm has made it too valuable to be longer devoted to agricultural purposes.

The legislature has appropriated $600 to be used in continuing the insecticide and fungicide experiments begun a year ago in the commercial orchards of this State, by C. M. Weed, D. Sc. This work will be in charge of W. J. Green, horticulturist of the station and will be carried on in 1891 in at least five localities. One thousand dollars has also been appropriated for two or three field tests with fertilizers on representative soils in different parts of the State. It is proposed to lease small areas of suitable land, which are to be thoroughly underdrained and laid out in permanent plats for continuous experiments with chemical and other manures.

PENNSYLVANIA STATION.—C. H. Zink, jr., has been appointed assistant in field and feeding experiments.

TENNESSEE COLLEGE AND STATION.—Chas. F. Vanderford has entered on his duties as professor of agriculture in the college and assistant director of the station.

TEXAS STATION.—Investigations on the effects of cotton seed and cotton-seed meal as food for dairy cows, with special reference to the influence of these feeding stuffs on gravity creaming, have given important results. The details of the investigation will be published in Bulletin No. 14 of the station.

VERMONT STATION.—A. B. Cordley, B. S., microscopist, has resigned to accept a position in the Division of Entomology of the United States Department of Agriculture.

LIST OF PUBLICATIONS OF THE UNITFD STATES DEPARTMENT OF AGRICULTURE.

MAY 1 TO JUNE 1, 1891.

DIVISION OF ENTOMOLOGY:

Circular No. 1 (second series), May, 1891.—Some of the more Important Insecticides.

Bulletin No. 23.—Reports of Observations and Experiments in the Practical Work of the Division.

Bulletin No. 24.—The Boll-Worm of Cotton.

Periodical Bulletin, Vol. III, Nos. 7 and 8, April, 1891.—Insect Life.

DIVISION OF CHEMISTRY:

Bulletin No. 29.—Record of Experiments with Sorghum in 1890.

Bulletin No. 30.—Experiments with Sugar-Beets in 1890.

DIVISION OF POMOLOGY:

Bulletin No. 4.—Report on the Relative Merit of Various Stocks for the Orange.

DIVISION OF STATISTICS:

Report No. 84 (new series), May, 1891.—Report on the Condition of Winter Grain; The Progress of Cotton Planting; Freight Rates of Transportation Companies.

DIVISION OF VEGETABLE PATHOLOGY:

Bulletin, Vol. VI, No. 4.—Journal of Mycology.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, Vol. II, No. 10, May, 1891.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

MAY 1 TO JUNE 1, 1891.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 108, May, 1891.—Examination of the Seed of Orchard Grass; Ash Analysis of White Globe Onions; On the Determination of Fat in Cream by the Babcock Method.

STORRS SCHOOL AGRICULTURAL EXPERIMENT STATION:
Third Annual Report, 1890.

IOWA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 12, February, 1891.—Experiments with Potatoes; Sugar-Beets; Sorghum; Relative-Value Table for Milk; Notes and Experiments upon Injurious Insects and Insecticides; A Feeding Experiment.

KANSAS AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 16, December, 1890.—Experiments with Sorghum and with Sugar-Beets.
Bulletin No. 17, December, 1890.—Crossed Varieties of Corn, Second and Third Years.

KENTUCKY AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 33, April, 1891.—Corn Experiments.

MAINE STATE COLLEGE AGRICULTURAL EXPERIMENT STATION:
Annual Report, Part II, 1890.

MARYLAND AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 11, December, 1890.—Tomatoes.

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION:
Analyses of Commercial Fertilizers, April, 1891.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:
Bulletin No. 13, April, 1891.—Directions for the use of Fungicides and Insecticides.
Bulletin No. 14, May, 1891.—Fertilizers for Corn.
Meteorological Bulletin No. 28, April, 1891.

EXPERIMENT STATION OF MICHIGAN AGRICULTURAL COLLEGE:
Bulletin No. 73, April, 1891.—Kerosene Emulsion; Some New Insects.
Bulletin No. 74, May, 1891.—Foot Rot in Sheep.

AGRICULTURAL EXPERIMENT STATION OF NEBRASKA:
Fourth Annual Report, 1890.

NEVADA AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 12, April, 1891.—Sugar-Beet Culture.

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION:
Bulletin No. 12, March, 1891.—Fertilizer Experiments.

NEW JERSEY STATE AND COLLEGE AGRICULTURAL EXPERIMENT STATIONS:
Bulletin No. 79, February 28, 1891.—Experiments with Nitrate of Soda on Tomatoes.
Bulletin No. 80, March 14, 1891.—Experiments with Fertilizers on Potatoes.

AGRICULTURAL EXPERIMENT STATION OF NEW MEXICO:

First Annual Report, 1890.

NEW YORK AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 27 (new series), February, 1891.—The New York State Fertilizer Control and Fertilizer Analyses; General Principles Underlying the use of Fertilizers.

Bulletin No. 28 (new series), April, 1891.—Pig-Feeding Experiments with Coarse Foods.

Bulletin No. 29 (new series), April, 1891.—Feeding Experiment with Laying Hens.

Bulletin No. 30 (new series), May, 1891.—Cabbages and Cauliflowers; Tomatoes.

Bulletin No. 31 (new series), May, 1891.—Commercial Valuation of the Food and Fertilizing Constituents of Feeding Materials.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 74, December 31, 1890.—Tests of Garden Vegetables and Fruits; Culture of Figs.

Bulletin No. 76, March, 1891.—Plant Diseases and how to Combat them.

NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

First Annual Report, 1890.

Bulletin No. 1, January, 1891.—Grain Smuts.

Bulletin No. 2, April, 1891.—Small Fruits.

OHIO AGRICULTURAL EXPERIMENT STATION:

Bulletin, Vol. IV, No. 1 (second series), January, 1891.—Experiments with Corn.

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 23, April, 1891.—Forest-Trees, Fruits, and Vegetables.

Bulletin No. 24, May, 1891.—Corn.

AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF WISCONSIN:

Bulletin No. 27, April, 1891.—The Feeding Value of Whey.

DOMINION OF CANADA.

ONTARIO AGRICULTURAL COLLEGE EXPERIMENT STATION:

Sixteenth Annual Report, 1890.

Bulletin No. 61, April 15, 1891.—Determination of Fat in Milk.

Bulletin No. 62, April 25, 1891.—Bark-Louse and Pear-Tree Slug.

EXPERIMENT STATION RECORD.

Vol. 2. JULY, 1891. No. 12.

EDITORIAL NOTES.

The present number completes the second volume of the Experiment Station Record. A classified table of contents and a full index have been prepared for this volume. The table of contents contains a catalogue of the abstracts of 329 bulletins and 42 annual reports of the stations, and 36 publications of this Department. The total number of pages included in these publications is 14,781. The station publications abstracted comprise bulletins published in 1890 and during a part of 1891, as well as annual reports for 1889 and 1890, including nearly all the reports for those years which have been received in this Office. As stated in a previous number of the Record (p. 391), the irregularity with which the station publications are issued makes it impracticable to give any exact time limit to those which are to be abstracted in a single volume.

The Record aims to give a rapid and impartial review of substantially all the publications of the stations and this Department. The mass and variety of this literature, it is believed, is a sufficient justification for the attempt to condense into a single publication an outline which will enable the student of the present or the future to readily find out what has been published either by the stations or the Department in any given line. The fact that under present conditions a considerable portion of this literature is of transient value only makes it more necessary that some means should be devised for ligh'ening the labors of those who wish to pursue thorough investigations. To attempt to sift out whatever is of permanent value and to discard the rest would result in leaving the student of the work of these institutions for research in agriculture in doubt in any particular case whether after all he had really obtained knowledge of all their work which might be of service to him. It is believed however that sufficient details regarding the methods and results of the more original and important investigations of the stations have been given to enable the investigator to get considerable general information regarding work in lines in which he is not a specialist, as well as in his own field, and the intelligent lay reader to at least understand the practical results of station work.

The table of contents and index to the volume have been made in considerable detail, with a view to meeting the needs of persons consulting the Record from many different points of view.

As time passes there will doubtless be a steady increase in the number of those who will receive the Record without having anything like a complete collection of the publications on which the Record is based. It is the desire of this Department, as well as of the stations, to do all in its power to render available to students of agriculture whatever information can be furnished by the Department or the stations. Already a very considerable correspondence has been had with individual readers of the Record who have desired to obtain particular publications of the stations or the Department, or to gain information supplementary to that furnished in such publications. It is hoped that the purpose of the Department and the stations to render such aid in this direction as it may be practicable to give may be clearly understood.

From an account of the agricultural experiment stations in Holland by Professor Adolf Mayer, director of the station at Wageningen,* we learn that there are now four stations in that country. The oldest is that at Wageningen, established in 1877. The others were organized in 1889 at Groningen, Hoorn, and Breda. The station at Wageningen is in connection with the national agricultural school, and has of late devoted itself more especially to scientific inquiries.

The four stations have one common board of control which is composed of from five to seven members. The members of this board are appointed by the Government for a term of 5 years, but may be reappointed at the end of that time. Each station has a director, one or more assistants, and a helper, all of whom are appointed and may be removed by the minister of commerce (*Handelsminister*). In addition to a regular salary, the director receives 5 per cent, each assistant 3 per cent, and each helper 1 per cent of the receipts for analyses made at the station. The stations all use the same methods of analysis, this being required by the statute under which they are organized. Certain analyses are made free of charge; others are paid for according to a fixed tariff. In case an analysis is not satisfactory to the sender of the material, appeal can be made to the central station at Wageningen.

The directors of the four stations form a counseling board, over which the director of the station at Wageningen presides. This board meets at least twice a year at the different stations in turn, at which meetings, among other things, a report is read of the condition and progress at each station since the last meeting, and the official methods of analyses are decided upon. None of these methods can be adopted for a longer time than one year at any meeting. This board also submits to the Government an annual report of all the stations.

The directors of the stations are at present as follows: Wageningen, Professor Adolf Mayer; Breda, Dr. A. J. Swaving; Groningen, Dr. A. F. Holleman; Hoorn, C. J. v. Lookeren-Campagne. Professor Mayer has three assistants; the others, one each.

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* Landw. Versuchs-Stationen, 38, pp. 441-446.

COMPILATION OF ANALYSES OF AMERICAN FEEDING STUFFS.

A compilation of analyses of American feeding stuffs has been prepared for this Department by E. H. Jenkins, Ph. D., vice-director, and A. L. Winton, jr., Ph. B., chemist, of the Connecticut State Station, and will be issued through this Office as soon as practicable. It is intended to include all analyses of American feeding stuffs which were published before September 1, 1890, and were accessible to the compilers. The analyses are collated from the publications of 49 experiment stations, of this Department, and of schools, colleges, and agricultural societies in the United States and Canada. The earliest were analyses of corn (kernel), made in 1869 in the chemical laboratory of the Sheffield Scientific School, under the direction of Professor S. W. Johnson. The total number of specimens of which analyses are given is 3,273. The compilers say:

It has been our aim to limit ourselves quite strictly to mere compilation, thus presenting in the most accessible shape a complete record of the work which has been done in this country in the line of proximate analysis of feeding stuffs, with a reference in every case to the original publication. * * *

It is probable that there was greater divergence in the methods of analysis in this country in former years than there is at present, although it is within our knowledge that all analyses made at the Bussey Institution and at the Connecticut Experiment Station at Middletown, beginning in 1875, and at New Haven, beginning in 1877, as well as those made still earlier at New Haven in the Sheffield Scientific School, were all done by the original Weende methods of Henneberg and Stohmann until the methods were modified to accord with those of the Association of Official Agricultural Chemists. These include nearly all the analyses made previous to 1880.

The American Association of Official Agricultural Chemists, which was organized in 1884 and which first took up the consideration of methods of the proximate analysis of feeding stuffs in 1887, has done very much to introduce uniformity into the methods and work of all laboratories in this country, and it is believed that since 1887 the official methods of the association have come into use in nearly all our station laboratories. In view of this fact we have aimed to arrange the different analyses of each material in something like chronological order. Other things being equal, the later analyses of different laboratories should be more nearly comparable with each other than the older analyses. * * *

Realizing the difficulties and uncertainties [of computing averages from the data collected], we have yet felt justified in inserting statements of the average composition of most of the feeding stuffs. Our object has been to supply data which might serve as a help and general guide in practical cattle feeding till further study and more accurate analyses shall provide something better.

The computations of average composition with minima and maxima are included in a final table, which is reproduced herewith in the belief that it will be widely and warmly welcomed.

COMPOSITION OF AMERICAN

COMPILED AND CALCULATED BY E. H.

	Number of analyses.	In fresh or air-dry material.								
		Water.			Ash.			Protein (N×6.25).		
		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
GREEN FODDER.										
CEREAL GRASSES:										
Corn (maize) fodder *a*—		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Flint varieties	40	51.5	90.8	**70.8**	0.7	1.8	**1.1**	0.6	4.0	**2.0**
Flint varieties, cut after kernels had glazed	10*b*	69.7	83.7	**77.1**	0.9	1.7	**1.1**	1.5	2.7	**2.1**
Dent varieties	63	59.5	93.6	**79.0**	0.6	2.5	**1.2**	0.5	3.8	**1.7**
Dent varieties, cut after kernels had glazed	7*b*	59.5	80.7	**73.4**	1.0	2.2	**1.5**	1.0	3.3	**2.0**
Sweet varieties	21	69.3	92.9	**79.1**	0.8	2.6	**1.3**	0.9	2.7	**1.9**
All varieties	126*c*	51.5	93.6	**79.3**	0.6	2.6	**1.2**	0.5	4.0	**1.8**
Leaves and husks, cut green	4	57.9	71.3	**66.2**	2.1	4.4	**2.9**	1.8	2.4	**2.1**
Stripped stalks, cut green	4	74.5	77.4	**76.1**	0.6	0.8	**0.7**	0.4	0.6	**0.5**
Sorghum, whole plant	11	63.9	86.4	**79.4**	0.7	2.3	**1.1**	0.9	2.6	**1.3**
Rye fodder	7	74.7	84.3	**76.6**	1.3	2.4	**1.8**	2.3	3.0	**2.6**
Oat fodder	5	31.3	78.6	**62.2**	1.5	4.2	**2.5**	1.5	6.1	**3.4**
OTHER GRASSES:										
Redtop *d* (*Agrostis vulgaris*) in bloom	5	51.5	76.2	**65.3**	1.7	2.9	**2.3**	2.0	4.3	**2.8**
Tall oat grass *e* (*Arrhenatherum avenaceum*) in bloom	3	62.3	73.5	**69.5**	1.6	3.0	**2.0**	1.7	3.3	**2.4**
Orchard grass (*Dactylis glomerata*) in bloom	4	66.9	77.3	**73.0**	1.6	2.9	**2.0**	1.9	4.1	**2.6**
Meadow fescue (*festuca pratensis*) in bloom	4	67.6	73.2	**69.9**	1.6	2.0	**1.8**	1.8	2.7	**2.4**
Timothy *f* (*Phleum pratense*)—										
All analyses	56	47.0	78.7	**61.6**	1.4	3.2	**2.1**	1.3	3.8	**3.1**
Before bloom, headed	3	61.7	78.6	**70.7**	1.8	1.8	**1.8**	3.0	3.6	**3.3**
In full bloom	14	57.8	71.9	**65.1**	1.4	2.5	**2.0**	1.3	3.7	**2.8**
Just after bloom	5	56.3	65.2	**59.4**	1.7	2.9	**2.3**	2.0	3.8	**2.9**
In seed, nearly ripe	4	53.0	77.8	**62.3**	1.6	2.8	**2.2**	2.0	3.0	**2.5**
Kentucky blue-grass *g* (*Poa pratensis*)—										
All analyses	18	51.7	82.5	**65.1**	1.6	4.8	**2.8**	2.4	7.2	**4.1**
Before bloom, headed	3	59.9	70.8	**64.7**	1.6	3.7	**2.8**	4.1	7.2	**5.3**
In bloom	5	62.9	75.7	**69.1**	1.6	3.1	**2.4**	2.4	3.6	**3.2**
Past bloom and in seed	4	51.7	55.9	**54.4**	2.8	4.8	**3.4**	3.3	5.5	**4.2**
LEGUMES:										
Red clover (*Trifolium pratense*)—										
All analyses	43	47.1	91.8	**70.8**	0.9	4.0	**2.1**	1.7	7.1	**4.4**
Before bloom	2	61.2	82.7	**72.0**	1.5	3.2	**2.4**	4.4	5.5	**5.0**
In bloom	5	47.1	91.8	**72.7**	0.9	4.0	**2.2**	1.7	7.1	**4.3**
After bloom and in seed	4	61.1	74.2	**68.2**	1.9	2.5	**2.2**	4.0	5.5	**4.5**
Alsike clover *h* (*Trifolium hybridum*) in bloom	4	72.3	77.3	**74.8**	1.9	2.1	**2.0**	3.6	4.2	**3.9**
Alfalfa *i* (*Medicago sativa*)—										
All analyses	23	49.8	82.0	**71.8**	1.8	5.1	**2.7**	3.5	7.7	**4.8**
Cow-pea	10	72.8	93.1	**83.6**	1.2	2.7	**1.7**	1.5	3.5	**2.4**
Soja bean	6	69.4	81.2	**74.8**	2.2	2.6	**2.4**	2.2	3.9	**3.0**
SILAGE.										
Corn (maize) silage	99	62.4	87.7	**79.1**	0.3	3.3	**1.4**	0.7	3.6	**1.7**
Corn (maize) kernels, ensiled	9	21.1	54.4	**41.3**	0.6	1.7	**1.0**	4.6	10.1	**6.0**
Sorghum silage	6	71.9	78.0	**76.1**	0.8	1.2	**1.1**	0.6	0.9	**0.8**

a Corn fodder is the entire plant, usually a thickly planted crop. Corn stover is what is left after the ears are harvested.

b Included in the analyses immediately preceding.

c Including two unclassified varieties.

d Herd's grass of Pennsylvania.

e Meadow oat grass.

f Herd's grass of New England and New York.

g June grass.

h Swedish clover.

i Lucern.

FEEDING STUFFS.

JENKINS AND A. L. WINTON, JR.

In fresh or air-dry material. Crude fiber. Minimum.	In fresh or air-dry material. Crude fiber. Maximum.	In fresh or air-dry material. Crude fiber. Average.	In fresh or air-dry material. Nitrogen-free extract. Minimum.	In fresh or air-dry material. Nitrogen-free extract. Maximum.	In fresh or air-dry material. Nitrogen-free extract. Average.	In fresh or air-dry material. Fat. Minimum.	In fresh or air-dry material. Fat. Maximum.	In fresh or air-dry material. Fat. Average.	Calculated to water-free substance. Ash. Average.	Calculated to water-free substance. Protein. Average.	Calculated to water-free substance. Fiber. Average.	Calculated to water-free substance. Nitrogen-free extract. Average.	Calculated to water-free substance. Fat. Average.
P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
2.1	11.4	4.3	4.3	36 3	12.1	0 3	1.3	0.7	5.2	9.7	21.3	60.6	3.2
3.0	6.1	4.8	10 0	19.7	14.6	0.6	1 3	0.8	5.0	9.2	18.9	63.2	3.7
2.0	11.0	5.6	3.0	27.0	12.0	0.1	1.6	0.5	5 7	8.3	26.3	57.1	2.6
5.4	8.5	6.7	11.6	27.0	15.5	0.4	1.6	0.9	5.4	7.5	25.2	58.7	3.2
1.9	8.5	4.4	3.2	19.4	12.8	0.1	1.0	0.5	6.0	8.9	21.2	61.7	2.2
1.9	11.4	5.0	3.0	36.3	12.2	0.1	1.6	0.5	5.6	8.8	24.1	58.9	2.6
6.6	12.5	8.7	16.7	22.2	19.0	1.0	1.3	1.1	8.5	6 2	25.7	56.4	3.2
6.7	8.8	7.8	14.2	16.0	14.9	0.4	0.6	0.5	2.9	2.3	30.7	62.0	2.1
4.7	9.1	6.1	5.3	21.5	11.6	0.2	1.1	0.5	5.3	6 5	29 7	56.2	2.3
4.7	14.9	11.6	4 9	12.4	6.8	0.2	0.7	0.6	7.7	11.1	49.4	29.3	2.5
7.1	16.8	11.2	10.8	39.8	19.3	0 4	3.0	1.4	6.6	9.1	29.5	51.1	3.7
8.0	15.7	11.0	11.7	21.9	17.7	0.6	1 1	0.9	6.6	7.9	31.5	51.6	2.4
9.2	9.7	9.4	13.0	20.7	15.8	0.6	1.5	0.9	6.7	7.8	30.7	51.8	3.0
5.8	11.1	8.2	9.9	16.6	13.3	0.7	1.3	0.9	7.4	9.6	30.4	49.3	3.3
10.2	11.3	10.8	12.5	15.7	14.3	0.7	1.1	0.8	6.0	8.0	35.7	47.5	2.8
5.1	19.4	11.8	10.1	28.6	20.2	0.6	2.0	1.2	5.4	8.0	30.7	52.8	3.1
5.1	12.7	7.9	10 1	19.4	15.3	0 8	1.3	1.0	6.2	11.4	27.0	52.0	3.4
6.4	13.9	10.4	13.9	22 4	18.7	0 7	1.5	1.0	5.7	7.9	29 9	53.6	2.9
11.1	13.7	12.6	18.0	23 6	21.5	0.9	2.0	1.3	5.7	7.1	30.9	53 2	3.1
5.1	15.8	11.5	11.3	28.6	20.4	0.8	1.3	1.1	5.7	6.6	30.7	54.2	2.8
3.8	14.8	9.1	6.5	26.6	17.6	0.8	1.9	1.3	8.0	11.8	26.2	50.3	3.7
6.7	12.8	9.5	14 9	19.0	16.3	1 2	1.6	1.4	8.0	15.1	26.8	46.1	4.0
6.7	10.8	8.3	11.2	18.7	16.1	0.8	1.2	0.9	7.7	10.3	26.7	52.3	3.0
10.6	14.8	11.8	23.2	26.6	24.5	1.5	1.9	1.7	7.5	9.1	25.8	53.9	3.7
1.8	14.7	8.1	3.5	25.8	13.5	0.3	1.8	1.1	7.2	15.3	27.8	45.8	3.9
2.3	10.8	6.5	8 1	18.6	13.3	0.7	1.0	0.8	8.6	17.8	23.2	47.5	2.9
1.8	14 7	6.5	3.5	25.8	13.4	0.3	1.3	0.9	8.1	15.7	23.8	49.2	3.2
5.0	12.4	7.2	12.9	20.2	16.7	0.9	1.7	1.2	6.9	14.2	22.6	52.5	3.8
.5.3	9.4	7.4	10.8	11.5	11.0	0.6	1.2	0.9	7.8	15.3	29.2	44.0	3.7
2.5	14.8	7.4	7.9	26.2	12.8	0.5	2.2	1.0	9.4	17.1	26.2	43.9	3.4
1.7	15.3	4.8	1.8	12.0	7.1	0.2	0.6	0.4	10.5	14.3	29.0	43.6	2 6
5.6	8.9	7.3	5.8	16.0	11.5	0.7	1.5	1.0	9.5	12.0	29.0	45.7	3.8
3.0	10.5	6.0	5.1	24.2	11.1	0.2	2.0	8.0	6.6	8.0	28.6	53.0	3.8
0.8	3.7	1.5	35.7	59.1	46.6	2.8	4.4	3.6	1.7	10.2	2.6	79.4	6.1
5.9	6.8	6.4	13.8	19.0	15.3	0.1	0.5	0.3	4.4	3.3	26.8	64.2	1.3

	Number of analyses.	In fresh or air-dry material.								
		Water.			Ash.			Protein. (N.×6.25).		
		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
SILAGE—continued		P. ct	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
Browers' grain silage	3	66.8	73.9	**69.8**	1.0	1.4	**1.2**	5.9	7.1	**6.6**
Red clover silage	5	61.4	78.6	**72.0**	1.9	3.0	**2.6**	3.0	5.9	**4.2**
HAY AND DRY COARSE FODDER.										
Corn (maize) fodder, field-cured	35	22.9	60.2	**42.2**	1.5	5.5	**2.7**	2.7	6.8	**4.5**
Corn (maize) leaves, field cured	17	14 8	44.0	**30.0**	4.3	7.4	**5.5**	4.5	8.3	**6.0**
Corn (maize) husks, field-cured	16	26.7	76.6	**50.9**	0.6	2.3	**1.8**	1.3	3.2	**2.5**
Corn (maize) stalks, field cured	15	51.3	78.5	**68.4**	0.6	2.0	**1.2**	1.2	3.0	**1.9**
Corn (maize) stover, field-cured	60	15.4	57.4	**40.5**	1.7	7.0	**3.4**	1.8	8.3	**3.8**
Hay from grasses named:										
Couch grass* (*Agropyrum repens*)	5	6.3	14.3	**14.3**	4.8	8.0	**6.0**	8.5	10.8	**8.8**
Redtop (*Agrostis vulgaris*)	9	6.8	11 6	**8.9**	3 8	7.0	**5.2**	5.9	10.4	**7.9**
Redtop cut in bloom (*Agrostis vulgaris*)	3	6.8	11.6	**8.7**	4.8	6.5	**4.9**	7.8	10.4	**8.0**
Orchard grass (*Dactylis glomerata*)	10	6.5	13.6	**9.9**	5.0	7.9	**6.0**	6.6	10.4	**8.1**
Timothy (*Phleum pratense*)—										
All analyses	68	6 1	28.9	**13.2**	2.5	6 3	**4.4**	3 8	9.7	**5.9**
Cut in full bloom	12	7.0	28 9	**15.0**	2.5	6.0	**4.5**	5.0	7.5	**6.0**
Cut soon after bloom	11	7.8	21.6	**14.2**	3.5	5.4	**4.4**	4.6	8.1	**5.7**
Cut when nearly ripe	12	7 0	22.7	**14.1**	2.7	5.1	**3.9**	4.3	6.0	**5.0**
Hungarian grass (*Setaria italica*)	12	4.9	9.5	**7.7**	5.0	7.5	**6.0**	4.7	12.3	**7.5**
Creek sedge (*Spartina stricta*, var. *glabra*)	5	7.4	9.7	**8.3**	8.3	15.3	**10.7**	4.0	8.4	**6.6**
Hay from legumes named:										
Red clover (*Trifolium pratense*)	38†	6 0	31 3	**15.3**	3.9	8.3	**6.2**	10.0	20.8	**12.3**
Red clover (*Trifolium pratense*), in bloom	6	6.0	31.3	**20.8**	5.6	8.3	**6.6**	10.8	15.4	**12.4**
Red clover (*Trifolium pratense*, var. *medium*)	10	7.3	29.4	**21.2**	4.5	9.5	**6.1**	9.0	16.8	**10.7**
Red clover (*Trifolium pratense*, var. *medium*), in bloom	5	9 4	26.7	**20.9**	4.5	9.5	**6.6**	9.0	16.8	**11.5**
Alsike clover (*Trifolium hybridum*)	9	5.3	13.9	**9.7**	6 1	12.2	**8.8**	9.2	16.1	**12.8**
White clover (*Trifolium repens*)	7	6 1	13.5	**9.7**	4.5	13.8	**8.3**	13.9	20.0	**15.7**
Alfalfa (*Medicago sativa*)	21	4.6	16.0	**8.4**	3.1	10.4	**7.4**	10.2	20.3	**14.3**
Cow-pea	8	7 6	14.0	**10.7**	3 2	10.2	**7.5**	13.6	20.3	**16.6**
Black grass (*Juncus gerardi*)	20	6.7	13.2	**9.5**	4.9	9.2	**7.0**	5.4	11 6	**7.5**
Wheat straw	7	6.5	17.9	**9.6**	3.0	7.0	**4.2**	2.9	5.0	**3.4**
Rye straw	7	6.3	9.7	**7.1**	2.8	3.4	**3.2**	2.2	3.6	**3.0**
Oat straw	12	6.5	11.4	**9.2**	3.7	6.7	**5.1**	2.7	6.9	**4.0**
Buckwheat straw	3	9.0	10.4	**9.9**	4.9	6.5	**5.5**	3.3	7.8	**5.2**
TUBERS, ROOTS, BULBS, AND OTHER VEGETABLES.										
Potatoes	12	75.4	82.2	**78.9**	0.8	1.2	**1.0**	1.1	3.0	**2.1**
Sweet-potatoes	6	66.0	74.4	**71.1**	0.7	1.3	**1.0**	0.5	3.6	**1.5**
Red beets	9	85.8	92.2	**88.5**	0.7	1.6	**1.0**	1.1	1.8	**1.5**
Sugar-beets	19	80.5	90.8	**86.5**	0.4	1.2	**0.9**	1.1	3.2	**1.8**
Mangel-wurzels	9	86.9	94.4	**90.9**	0.8	1 4	**1.1**	1.0	1.9	**1.4**
Turnips	3	87.2	92.4	**90.5**	0.7	1.0	**0.8**	0.8	1.4	**1.1**
Ruta-bagas	4	87.1	91.8	**88.6**	1.0	1.4	**1.2**	1.0	1.3	**1.2**
Carrots	8	86.5	91.1	**88.6**	0.6	1.3	**1.0**	0.8	2.0	**1.1**
Onions	6	81.5	93.5	**87.6**	0.4	0.7	**0.6**	0.8	2.3	**1.4**
Cucumbers	2	95.7	96.3	**96.0**	0.5	0.5	**0.5**	0.8	0.8	**0.8**
Cabbages	2	87.3	93.6	**90.5**	0.7	2.1	**0.8**	2.1	2.7	**2.4**
Asparagus	3	93.6	94.3	**94.0**	0.5	1.0	**0.7**	1.6	2.1	**1.8**
Strawberries	19	87.7	94.0	**90.8**	0.4	0.8	**0.6**	0.6	1.2	**1.0**
Lemons	2	88.4	90.0	**89.3**	0.5	0.5	**0.5**	0.8	1.1	**1.0**

* Quack grass, quick or quitch grass, twitch or dog's grass. † Including the 21 analyses following.

FEEDING STUFFS—Continued.

In fresh or air-dry material.									Calculated to water-free substance.				
Crude fiber.			Nitrogen-free extract.			Fat.			Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Average.	Average.	Average.	Average.	Average.
P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct*	*P. ct*	*P. ct*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
3.9	5.4	4.7	13.7	16.9	15.6	1.8	2.6	2.1	4.0	22.0	15.4	51.7	6.9
5.1	13.9	8.4	8.1	14.3	11.6	0.9	1.6	1.2	9.3	15.0	29.9	41.7	4.1
7.5	24.7	14.8	20.6	47.8	34.7	0.6	2.5	1.6	4.6	7.8	24.7	60.1	2.8
17.4	27.4	21.4	27.3	41.4	35.7	0.8	2.2	1.4	7.8	8.4	30.8	51.4	1.9
6.8	23.6	15.8	14.3	43.6	28.3	0.5	1.0	0.7	3.5	5.0	32.2	57.9	1.4
6.9	16.8	11.0	11.2	26.0	17.0	0.3	1.0	0.5	3.6	5.9	34.8	54.1	1.6
14.1	32.2	19.7	23.3	53.3	31.5	0.7	2.2	1.1	5.8	6.4	33.1	52.8	1.9
16.6	34.5	24.8	38.5	49.5	43.1	2.9	3.4	3.0	7.0	10.3	29.0	50.2	3.5
24.0	31.8	28.6	44.8	50.4	47.4	1.4	3.2	1.9	5.7	8.7	31.4	52.1	2.1
24.0	31.8	29.9	46.8	47.8	46.4	1.5	2.3	2.1	5.4	8.7	32.8	50.8	2.3
28.9	38.3	32.4	32.9	48.6	41.0	1.7	3.3	2.6	6.7	9.0	36.0	45.4	2.9
22.2	38.5	29.0	34.3	58.5	45.0	1.0	4.0	2.5	5.1	6.8	33.5	51.7	2.9
22.2	37.1	29.6	34.4	48.5	41.9	2.0	4.0	3.0	5.3	7.1	34.7	49.4	3.5
25.7	33.4	28.1	37.0	51.0	44.6	1.7	3.6	3.0	5.1	6.6	32.7	52.1	3.5
24.8	38.5	31.1	38.0	49.1	43.7	1.0	2.8	2.2	4.5	5.8	36.2	50.9	2.6
23.6	36.3	27.7	44.4	53.0	49.0	1.5	3.5	2.1	6.5	8.1	30.0	53.1	2.3
25.5	27.7	26.9	39.0	51.3	45.4	1.8	2.2	2.1	11.6	7.1	29.3	49.7	2.3
15.6	35.7	24.8	27.3	52.2	38.1	1.5	5.9	3.3	7.3	14.5	29.1	45.2	3.9
17.9	28.1	21.9	27.3	41.3	33.8	2.5	5.9	4.5	8.3	15.6	27.5	43.0	5.6
18.3	29.4	21.5	28.6	44.4	33.6	3.9	5.3	3.9	7.3	13.5	31.3	43.0	4.9
18.8	27.8	24.7	28.6	44.4	33.0	1.6	5.1	3.3	8.2	14.6	31.1	41.9	4.2
19.7	20.5	25.6	35.6	45.9	40.7	1.6	4.2	2.9	9.3	14.2	28.4	44.9	3.2
20.3	30.3	24.1	33.4	47.3	39.8	1.7	5.8	2.9	9.2	17.4	26.7	43.5	3.2
14.0	33.0	25.0	35.1	53.6	42.7	1.1	3.8	2.7	8.1	15.6	27.3	46.6	2.4
16.4	26.0	20.1	39.4	49.5	42.2	1.1	3.7	2.9	8.5	18.6	22.5	47.2	3.2
20.4	35.9	25.9	42.5	53.4	47.7	1.1	3.2	2.4	7.6	8.2	28.5	53.0	2.7
34.3	42.7	38.1	31.0	50.6	43.4	0.8	1.8	1.3	4.6	3.8	42.1	48.1	1.4
32.7	43.3	38.9	41.0	52.9	46.6	1.0	1.6	1.2	3.4	3.2	41.9	50.2	1.3
31.8	45.1	37.0	33.5	46.6	42.4	1.7	3.2	2.8	5.6	4.4	40.7	46.8	2.5
37.2	40.8	43.0	32.1	38.9	35.1	0.7	1.7	1.3	6.1	5.8	47.7	39.0	1.4
0.3	0.9	0.6	14.1	20.4	17.3	0.0	0.1	0.1	4.5	10.1	2.7	82.2	0.5
0.6	2.5	1.3	18.0	29.7	24.7	0.3	0.6	0.4	3.5	5.2	3.6	86.3	1.4
0.6	1.7	0.9	3.8	11.3	8.0	0.1	0.3	0.1	9.1	13.4	7.8	68.4	1.3
0.6	1.3	0.9	5.7	13.6	9.8	0.1	0.2	0.1	6.5	13.0	6.5	73.3	0.7
0.6	1.3	0.9	2.4	8.7	5.5	0.1	0.5	0.2	11.0	15.4	9.6	62.3	1.7
0.8	1.4	1.2	4.2	8.8	6.2	0.1	0.2	0.2	8.4	12.4	12.2	64.9	2.1
1.1	1.4	1.3	5.1	9.1	7.5	0.1	0.3	0.2	10.2	10.5	11.1	66.8	1.3
0.9	2.8	1.3	5.1	10.4	7.6	0.2	0.7	0.4	8.8	10.0	11.2	66.3	3.7
0.6	0.8	0.7	3.8	14.7	9.4	0.2	0.4	0.3	4.5	11.3	5.5	76.5	2.2
0.5	0.9	0.7	1.7	2.0	1.8	0.2	0.2	0.2	11.5	20.3	17.3	45.4	5.5
1.4	1.5	1.5	2.0	5.7	3.9	0.2	0.5	0.4	14.8	25.1	15.5	40.7	3.9
0.7	0.8	0.7	2.3	2.9	2.5	0.2	0.3	0.3	11.1	30.2	12.2	42.3	4.2
0.7	2.3	1.4	3.7	6.4	5.5	0.4	1.1	0.7	6.5	10.4	15.6	60.1	7.4
0.9	1.3	1.1	6.9	7.6	7.2	0.2	1.6	0.9	4.7	8.8	10.1	67.9	8.5

	Number of analyses.	In fresh or air-dry material.								
		Water.			Ash.			Protein. (N×6.25).		
		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
GRAINS AND OTHER SEEDS.										
Corn (maize) kernel—		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Dent, raised in Connecticut..	2	9.6	10.9	**10.8**	1.2	1.8	**1.6**	8.3	11.3	**10.1**
Dent, raised in Kansas	6	11.4	12.3	**11.9**	1.3	1.7	**1.5**	9.1	10.7	**10.2**
Dent, raised in Michigan	7	11.7	14.1	**13.1**	1.3	1.6	**1.4**	9.9	11.8	**11.0**
Dent, raised in Missouri	22	7.4	9.1	**8.2**	1.3	2.1	**1.7**	8.2	12.6	**10.5**
Dent, raised in Texas	19	9.3	12.1	**10.6**	1.0	1.7	**1.4**	9.8	11.0	**10.4**
Dent, raised in Wisconsin ...	5	13.7	19.4	**17.0**	1.3	2.6	**1.7**	8.7	10.3	**9.4**
Dent, all analyses	86	6.2	19.4	**10.6**	1.0	2.6	**1.5**	7.5	11.8	**10.3**
Flint, raised in Connecticut .	11	8.7	18.2	**14.2**	1.0	1.6	**1.3**	8.9	11.6	**10.1**
Flint, raised in Massachusetts	12	8.9	14.4	**11.1**	1.1	1.6	**1.4**	7.9	12.9	**11.1**
Flint, raised in Michigan. ...	4	12.9	13.5	**13.2**	1.4	1.5	**1.5**	10.7	12.0	**11.5**
Flint, raised in New Hampshire	11	8.3	11.5	**10.1**	1.3	1.8	**1.5**	10.5	13.7	**11.6**
Flint, all analyses	68	4.5	19.6	**11.3**	1.0	1.9	**1.4**	7.0	13.7	**10.5**
Sweet, raised in Massachusetts	6	6.3	10.9	**8.7**	1.6	1.9	**1.8**	11.6	14.4	**12.8**
Sweet, raised in Pennsylvania	8	7.0	9.5	**8.0**	1.7	2.4	**2.0**	9.5	11.7	**10.7**
Sweet, all analyses	26	6.0	10.9	**8.8**	1.4	2.4	**1.9**	9.5	15.3	**11.6**
Pop varieties	4	8.6	11.8	**10.7**	1.2	1.7	**1.5**	9.7	13.1	**11.2**
Soft varieties	5	6.1	14.1	**9.3**	1.4	1.9	**1.6**	8.8	14.6	**11.4**
All varieties and analyses....	208	4.5	20.7	**10.9**	1.0	2.6	**1.5**	7.0	15.3	**10.5**
Field-cured, dent varieties..	17	28.8	39.3	**34.2**	0.7	1.3	**0.9**	4.4	8.3	**6.3**
Field-cured, dent varieties, small and from immature ears	9	17.7	57.5	**36.6**	0.7	1.4	**1.0**	6.2	8.6	**6.7**
Field-cured, flint varieties ...	48	22.0	32.1	**27.1**	0.6	1.6	**1.3**	5.6	10.4	**8.0**
Field-cured, flint varieties, small and from immature ears	7	24.0	74.8	**34.5**	0.4	1.0	**0.8**	3.3	10.3	**7.9**
Sorghum seed	10	9.3	16.8	**12.8**	1.4	4.3	**2.1**	7.7	11.3	**9.1**
Barley.........................	10	7.2	12.6	**10.9**	1.8	3.2	**2.4**	8.6	15.7	**12.4**
Oats.........................	30	8.9	13.5	**11.0**	2.0	4.0	**3.0**	8.0	14.4	**11.8**
Rye	6	8.7	13.2	**11.6**	1.8	1.9	**1.9**	9.5	12.1	**10.6**
Wheat, spring varieties	13	8.1	13.4	**10.4**	1.5	2.6	**1.9**	8.4	15.4	**12.5**
Wheat, winter varieties, raised in—										
Alabama	17	9.4	12.4	**10.9**	1.8	2.4	**2.0**	9.8	13.7	**11.4**
California	4	10.7	11.2	**11.0**	1.5	2.0	**1.8**	8.3	13.8	**11.1**
Colorado	50	7.9	10.6	**9.6**	1.8	3.6	**2.2**	11.2	15.9	**13.3**
Georgia	8	8.0	12.2	**9.9**	1.6	2.3	**1.9**	9.5	14.0	**11.6**
Indiana	8	9.9	12.4	**10.8**	1.4	2.1	**1.8**	11.9	14.5	**13.2**
Maryland	9	8.4	11.9	**10.5**	1.4	2.2	**1.8**	9.8	14.5	**11.7**
Michigan.	23	9.1	13.8	**10.8**	1.0	2.1	**1.7**	9.1	15.2	**11.6**
	12	7.7	13.5	**9.8**	1.8	2.2	**1.9**	10.5	14.0	**11.6**
New Jersey	13	13.3	14.0	**13.7**	1.8	2.2	**2.0**	9.2	12.5	**10.8**
North Carolina.............	22	8.2	11.7	**10.0**	1.2	1.9	**1.6**	8.9	12.4	**10.4**
	5	9.0	13.0	**9.9**	1.5	2.0	**1.7**	8.1	10.6	**8.6**
Pennsylvania	41	7.6	13.3	**10.7**	0.8	3.0	**1.6**	9.5	15.6	**11.8**
Tennessee....................	14	7.1	11.9	**10.2**	1.6	2.4	**1.9**	10.0	16.6	**12.5**
Virginia	11	8.8	12.3	**10.3**	1.1	2.5	**1.7**	10.2	14.0	**12.2**
Wheat, winter varieties, all analyses	262	7.1	14.0	**10.5**	0.8	3.6	**1.8**	8.1	16.6	**11.8**
Wheat, all complete analyses of all varieties	310	7.1	14.0	**10.5**	0.8	3.6	**1.8**	8.1	17.2	**11.9**
Rice..........................	10	11.4	14.0	**12.4**	0.3	.5	**0.4**	5.9	8.6	**7.4**
Buckwheat	8	10.9	14.8	**12.6**	1.6	2.3	**2.0**	8.6	11.0	**10.0**
Soja bean	8	5.9	19.3	**10.8**	3.1	5.4	**4.7**	26.3	40.2	**34.0**
Cow-pea.........................	5	10.0	20.9	**14.8**	2.9	3.4	**3.2**	19.3	23.0	**20.8**
MILL PRODUCTS.										
Corn (maize) meal	77	8.0	27.4	**15.0**	0.9	4.1	**1.4**	7.1	13.9	**9.2**
Corn-and-cob meal	7	9.5	26.3	**15.1**	1.2	1.9	**1.5**	5.8	12.2	**8.5**
Oatmeal........................	6	6.2	8.8	**7.9**	1.8	2.2	**2.0**	12.9	16.3	**14.7**

FEEDING STUFFS—Continued.

In fresh or air-dry material.									Calculated to water-free substance.				
Crude fiber.			Nitrogen-free extract.			Fat.			Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Average.	Average.	Average.	Average.	Average.
P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
1.3	2.2	1.7	69.2	73.4	71.8	3.8	5.2	4.5	1.8	11.3	1.9	80.0	5.0
1.7	2.7	2.2	68.4	71.7	69.8	4.5	5.1	4.9	1.7	11.6	2.5	78.6	5.6
2.0	2.5	2.8	66.3	67.8	67.4	4 6	5.0	4.8	1.6	12.6	2.6	77.7	5.5
1.4	3.1	2.4	69.8	74 8	71.8	4.3	7.5	5.4	1.9	11.4	2.6	78.2	5.9
1.8	4.2	2.8	66.7	71.8	69.3	5.0	6.6	5.5	1.6	11.6	3.1	77.6	6.1
1.3	2.9	1.8	65.4	68.1	66.8	3.1	4.3	3.8	2.9	11.3	2.1	79.1	4.6
0.9	4.8	2.2	65.9	75.7	70.4	3.1	7.5	5.0	1.7	11.5	2.6	78.6	5.6
0.8	1.5	1.2	65.0	72.3	68.6	3.9	5.7	4.6	1.5	11.8	1.3	80.0	5.4
1.1	2.5	1.9	66.5	74.2	69.8	3.4	5.9	4.7	1.6	12.4	2.1	78.6	5.3
2.0	2.5	2.2	66.0	67.4	66.6	4.8	5.1	5.0	1.7	13.2	2.5	76.8	5.8
0.8	1.3	1.1	67.6	73.3	70.2	4.7	7.1	5.5	1.7	12.8	1.2	78.2	6.5
0.7	2.9	1.7	65.0	76.7	70.1	3.4	7.1	5.0	1.7	11.8	1.9	79.0	5.6
1.6	2.6	2.1	65.5	68.9	67.0	3 8	9.2	7.6	2.0	14.0	2.3	73.4	8.3
3.0	5.2	3.7	62.5	69.1	66.6	7.8	11.9	9.0	2.2	11.6	4.0	72.4	9.8
1.5	5.2	2.8	61 8	72 4	66.8	3.8	9.3	8.1	2.1	12.8	3.1	73.2	8.8
1.2	2.3	1.8	68.4	71.1	69.6	4.2	6.0	5.2	1.7	12.5	2.0	77.9	5.8
1.3	3 3	2.0	66.0	75.5	70.2	5.0	5.7	5.5	1.8	12.5	2.2	77.4	6.1
0.7	5.2	2.1	61.8	76.7	69.6	3.1	9.3	5.4	1.7	11 7	2.4	78.1	6.1
0.9	1.8	1.2	50.3	59.4	53.9	2.9	4.0	3.5	1.3	9.6	1.8	81.9	5.4
0.9	1.8	1.1	33.5	68 2	51.2	1.8	4.3	3.4	1.6	10.6	1.8	80.6	5.4
0.7	1.6	1.3	53.9	64.4	58.1	3.4	5.3	4.2	1.7	10.9	1.8	79.8	5.8
.3	1.0	0.8	19.9	62 5	52.4	1.4	4.3	3.6	1.3	11.6	1.2	80.6	5.0
1.5	8.7	2.6	59.0	73.6	69.8	2.1	4.6	3.6	2.4	10.4	3.0	80.1	4.1
1.3	4.2	2.7	66.7	73.9	69.8	1.5	3.2	1.8	2.7	13.9	3.0	78.4	2.0
1.5	12.9	9.5	53.5	66 9	59.7	3 4	5.8	5.0	3 4	13.2	10.8	67.0	5.6
1.4	2.1	1.7	71.2	73.9	72.5	1.4	2.1	1.7	2.1	11.8	1.9	82.3	1.9
1.3	2.3	1.8	66.1	74.9	71.2	1.8	2.6	2.2	2.1	13.9	2.0	79.5	2.5
1.3	1.9	1.6	68.5	74.4	71.8	1.6	2.7	2.2	2.2	12.8	1.8	80.7	2.5
1.8	2.2	2.0	70.2	74.8	72.5	1.5	1.8	1.6	2 0	12.5	2.2	81.5	1.8
1.1	2.2	1.6	67.9	74.3	70.9	1.6	3.9	2.4	2.4	14.7	1.9	78.3	2.7
1.4	2.0	1.7	69.6	73.8	72.6	2.1	2.7	2.3	2.1	12.8	1.9	80.7	2.5
1.6	2.4	2.0	69.3	71.9	70.3	1.6	2.3	1.9	1.9	14.6	2.2	79.2	2.1
1.6	2.3	1.7	70.3	74.8	72.2	1.6	2.7	2.1	2.0	13.0	1.9	80.8	2.3
1.1	2.4	1.8	70.6	75.9	72.1	1.3	2.5	2.0	1.9	13.0	2.0	80.9	2.2
1.5	2.7	2.2	70.0	75.2	72.3	1.5	2.4	2.2	2.1	12.8	2.3	80.4	2.4
1.6	2.0	1.8	68.3	72.2	70.6	1.4	1.7	1.6	2.3	11.8	2.1	82.1	1.7
C.4	2.9	1.8	70.9	76 6	73.9	2.0	2.5	2.3	1.8	11.5	2.0	82.1	2.6
1.2	1.9	1.5	74.5	77.5	76.3	1.7	2.3	2.0	1.9	9.5	1.7	84.7	2.2
0.9	2.8	1.7	67.9	76.1	72.2	1.4	2.6	2.0	1.8	13.2	1.9	80.9	2.2
1.5	2.9	2.0	66.7	74.4	71.8	1.7	2.3	2.1	2.1	13.9	2.2	79.5	2.3
1.2	2.0	1.7	69.6	73.7	71.9	1.8	2.6	2.2	1.9	13.6	1.9	80.1	2.5
0.4	2.9	1.8	66.7	77.7	72.0	1.3	3.9	2.1	2.0	13.1	2.0	80.6	2.3
0.4	3.1	1.8	64.8	77.7	71.9	1.3	3.9	2.1	2.0	13.3	2.0	80.4	2.3
0.1	0.4	0.2	77.5	80.6	79.2	0.3	0.6	0.4	0.4	8.5	0.2	90.5	0.4
7.8	9.4	8.7	62.6	65 4	64.5	2.2	2.4	2.2	2.3	11.5	9.9	73.7	2.6
3.4	6.1	4.8	26.2	32 8	28.8	12.3	19.0	16.9	5.3	38.1	5.4	32.2	19.0
2.5	5.0	4.1	50.5	62.0	55.7	1.3	1.6	1.4	3.8	24.3	4.7	65.5	1.7
0.5	3.1	1.9	60.4	74.0	68.7	2.0	5.1	3.8	1.6	10.8	2.2	81.0	4.4
4.7	9.4	6.6	56.8	69.7	64.8	2.5	4.7	3.5	1.7	10.0	7.3	76.4	4.1
0.6	1.2	0.9	66.6	69.0	67.4	6.1	8.8	7.1	2.2	15.9	1.0	73.2	7.7

	Number of analyses.	In fresh or air-dry material.								
		Water.			Ash.			Protein (N × 6.25).		
		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
MILK PRODUCTS—Continued.		P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
Barley meal	3	9.9	13.6	**11.9**	1.6	3.8	**2.6**	9.8	12.7	**10.5**
Rye flour	4	12.4	13.6	**13.1**	0.6	0.8	**0.7**	6.0	6.9	**6.7**
Wheat flour, all analyses	20	8.2	13.6	**12.4**	0.3	0.7	**0.5**	8.6	13.6	**10.8**
Graham flour	3	12.1	13.7	**13.1**	1 7	2.0	**1.8**	11.2	12.4	**11.7**
Buckwheat flour	4	12.8	17.6	**14.6**	0.7	1.3	**1.0**	4.2	8.1	**6.9**
Ground linseed	2	7.9	8.3	**8.1**	3.4	6 1	**4.7**	20.3	23.0	**21.6**
Pea meal	2	8.9	12.1	**10.5**	2.6	2.7	**2.6**	19.1	21.4	**20.2**
Ground corn and oats, equal parts	6	10.7	13.1	**11.9**	1.9	2.7	**2.2**	8.4	10.4	**9.6**
WASTE PRODUCTS.										
Corn (maize) cob	18	7.2	24.8	**10.7**	0.7	2.7	**1.4**	1.2	3.7	**2.4**
Hominy chops	12	8.1	13.5	**11.1**	1.9	3.1	**2.5**	7.9	11.2	**9.8**
Corn (maize) germ	3	9.4	13.0	**10.7**	1.9	7.4	**4.0**	9 7	9.9	**9.8**
Gluten meal	32	6.4	12.3	**9.6**	0.1	1.7	**0.7**	15 0	37.9	**29.4**
Starch feed, wet	12	62.3	72.2	**65.4**	0.1	0.6	**0.3**	3.6	9.6	**6.1**
Oat feed	4	6 4	9.2	**7.7**	3.2	4.2	**3.7**	12.6	20.0	**16.0**
Barley screenings	2	12.0	12.4	**12.2**	3.5	3.6	**3.6**	12.1	12.5	**12.3**
Malt sprouts	4	7.3	12.0	**10.2**	3.8	6.7	**5.7**	21.0	25.9	**23.2**
Brewers' grains, wet	15	68.6	79.4	**75.7**	0.8	1.5	**1.0**	4.3	6.9	**5.4**
Brewers' grains, dried	3	6.2	11.9	**8.2**	3.3	3.8	**3.6**	19.3	20.3	**19.9**
Rye bran	7	8.2	13.7	**11.6**	2.9	4.5	**3.6**	11.5	16.8	**14.7**
Wheat bran, from spring wheat	10	7.4	13.6	**11.5**	4.0	6.0	**5.4**	14.3	18.1	**16.1**
Wheat bran, from winter wheat	7	10.6	13.6	**12.3**	5.0	6.4	**5.9**	13.9	17.8	**16.0**
Wheat bran, all analyses	88	7.4	15.8	**11.9**	2.5	7.8	**5.8**	12.1	18.9	**15.4**
Wheat middlings	32	9.2	16.0	**12.1**	1.4	6.3	**3.3**	10.1	20.0	**15.6**
Wheat shorts	12	4.1	15.5	**11.8**	2.0	6.2	**4.6**	11.1	19.4	**14.9**
Wheat screenings	10	7.8	13.6	**11.6**	1.9	3.8	**2.9**	8.3	16.9	**12.5**
Wheat-screenings meal	2	7.3	12.6	**10.0**	2.9	3.2	**3.1**	6.6	9.0	**7.8**
Wheat flour of screenings	3	12.1	13.3	**12.9**	2.9	3.2	**3.0**	7.3	10.2	**8.9**
Cockle bran	3	10.2	11.8	**11.1**	3.0	3.6	**3.2**	9.4	11.9	**10.6**
Rice bran	5	8.8	10.7	**9.7**	8.4	12.4	**10.0**	10.9	13.6	**12.1**
Rice hulls	3	7.7	8.5	**8.2**	10.5	15.1	**13.2**	2.9	4.7	**3.6**
Rice polish	4	9.0	11.2	**10.0**	2.8	11.3	**6.7**	10.9	12.9	**11.7**
Buckwheat middlings	3	9.5	16.3	**13.2**	4.4	5.5	**4.8**	25.1	31.3	**28.9**
Cotton-seed meal	35	5.8	18.5	**8.2**	5.7	8.8	**7.2**	23.3	50.8	**42.3**
Cotton-seed hulls	4	10.0	11.5	**10.4**	2.3	3.0	**2.6**	3.5	4.8	**4.0**
Linseed meal, old-process	21	5.6	12.4	**9.2**	4.6	8.2	**5.7**	27.7	38.2	**32.9**
Linseed meal new-process	14	6.0	13.4	**10.1**	5.0	6.9	**5.8**	27.1	38.4	**33.2**
Palm-nut meal	3	6.1	10.8	**8.3**	3.5	4.0	**3.7**	13.5	16.0	**14.4**
Apple pomace	7	69.9	82.5	**76.7**	0.2	0.8	**0.5**	1.0	1.7	**1.4**

FEEDING STUFFS—Continued.

In fresh or air-dry material.									Calculated to water-free substance.				
Crude fiber.			Nitrogen-free extract.			Fat.			Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Average.	Average.	Average.	Average.	Average.
P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
5.9	7.0	6.5	63.5	68.0	66.3	1.5	3.2	2.2	8.0	11.9	7.3	75.3	2.5
0.4	0.5	0.4	77.6	79.1	78.8	0.6	0.9	0.8	0.8	7.7	0.4	90.2	0.9
0.1	1.0	0.2	71.5	78.5	75.0	0.6	1.8	1.1	0.5	12.3	0.2	85.8	1.2
1.8	2.0	1.9	69 8	70.0	69.8	1.9	2.2	1.7	2.1	13.4	2.2	80.3	2.0
0.2	0.5	0.3	71.1	79.4	75.8	0.7	1.8	1.4	1.2	8.0	0.4	88.8	1.6
5.0	9.6	7.8	25.5	30.2	27.9	30.3	30.5	30.4	5.1	23.4	8.1	30.4	33.0
11.1	17.7	14.4	50.2	52.0	51.1	0.9	1.5	1.2	2.9	22.5	16.0	57.2	1.4
......	......	......	*70.4	*73.7	*72.0	4.0	5.0	4.4	2 4	10.9	......	*81.7	5.0
18.2	38.3	30.1	43.8	66.7	54.9	0.1	0.9	0.5	1.6	2.7	33.7	61.4	0.6
2.5	6.7	3.8	61.0	71.1	64.5	4.5	11.2	8.3	2.8	11.0	4.3	72.6	9.3
1.9	5.8	4.1	61.9	67.4	64.0	5.2	11.2	7.4	4.5	11.0	4.6	71.7	8.2
0.3	8.6	1.6	35.1	58.5	52.4	3.4	16.3	6.3	0.8	32.5	1.8	57.9	7.0
1.6	4.4	3.1	18.7	28 9	22.0	1.3	4.4	3.1	0.8	17.6	8 9	63.6	9.1
3.7	12.5	6.1	56.2	63 7	59.4	6.1	7.8	7.1	4 0	17.3	6.6	64.4	7.7
7.0	7.6	7.3	61.6	62.0	61.8	2.6	2.9	2.8	4.0	14.0	8.3	70.4	3.3
9 3	12.0	10.7	45.5	50 3	48.5	1.1	3.0	1.7	6.3	25.8	11.8	54.2	1.9
3.1	5 6	3.8	9.6	15 9	12.5	0.8	2.8	1.6	3.9	22 4	15.7	51.5	6.5
10.2	11.6	11.0	46.1	56.8	51.7	4 2	6.5	5.6	3 9	21.7	12.0	56.3	6.1
2.5	4.1	3.5	59 8	67.6	63.8	1.7	4.9	2.8	4.1	16.6	4.0	72.1	3.2
5.4	10.1	8.0	51 7	58.1	54.5	3.6	5.0	4.5	6.1	18.2	9.0	61.6	5.1
7.2	8.9	8.1	50.5	56.2	53.7	3.5	4.5	4.0	6.7	18.2	9.2	61.3	4.6
2.4	15.5	9.0	45.5	63 2	53.9	1.5	7.0	4.0	6.6	17 4	10.2	61.3	4.5
1 3	12.7	4.6	53.0	70.9	60.4	2.1	5.9	4.0	3.8	17.8	5.2	68.7	4.5
6.0	10.5	7.4	50 0	67.0	56.8	2.5	6.1	4.5	5.2	16.8	8.4	64.5	5.1
1.7	7.5	4.9	61.0	70.4	65.1	2.7	3.3	3.0	3.3	14.1	5.5	73.7	3.4
5.7	6.6	6.2	68.2	71.4	69.6	2.8	3.8	3.3	3.4	8.7	6.9	77.3	3.7
3.8	9.0	5.5	62 3	69 9	66.1	3.1	4.0	3.6	3.4	10.2	6.3	76.0	4.1
7.6	11.0	9.2	62.4	64 4	63.5	2.1	2.8	2.5	3.6	11 9	10.3	71.4	2.8
2.0	17 8	9.5	41.9	62.3	49.9	5.2	10.9	8.8	11.0	13.4	10.4	55.5	9.7
30.3	38.6	35.7	36 0	41.6	38.6	0.6	0.9	0.7	14.4	3 9	38.8	42 2	0.7
2.4	14.5	6.3	45.5	63.3	58.0	6.5	8.0	7.3	7.4	12.9	7.0	64 6	8.1
2.4	5.7	4.1	36.3	52 7	41.9	5 7	8 1	7.1	5.5	33.3	4.6	48.5	8.1
1.3	10.1	5.6	15.7	38.7	23.6	8.8	18.0	18.1	7.8	46.1	6.1	25.8	14.2
35.8	51.4	44.4	32.0	41.2	36.6	0.8	3.8	2.0	2.9	4.5	49.5	40 9	2.2
4.7	12.9	8.9	28.4	41 9	35.4	5.2	11.6	7.9	6.3	36.2	9.7	39.2	8.6
7.6	4.0	9.5	35.2	48.0	38.4	1.3	4.4	3.0	6.5	36 9	10 5	42.8	3.3
18.8	24.0	21.4	33.8	41.7	38.9	6.4	18.7	3.8	4.0	15.7	23.3	43.4	3.6
2.0	5.9	3.9	12.6	21.2	16.2	0.6	2.0	1.8	2.2	5.9	16.6	69.6	5.7

* Including fiber.

ABSTRACTS OF PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

Alabama College Station, Bulletin No. 23 (New Series), February, 1891 (pp. 64).

CO-OPERATIVE SOIL TESTS WITH FERTILIZERS, J. S. NEWMAN (pp. 3–61).—A report is given of 24 co-operative tests of fertilizers with cotton on typical soils in 22 counties of the State. The general plan of the experiment was as given in Bulletin No. 12 (new series) of the station (See Experiment Station Record, Vol. II, p. 9), and was closely followed in nearly every case. The land selected proved in most cases to be well adapted to the test, in some cases being unusually even in fertility. On 12 fifteenth-acre plats sulphate of ammonia, dissolved bone-black, and kainit were each used singly, two by two, and all three together; floats, green cotton-seed, and stable manure were each used alone; and floats were also used in combination with green cotton seed or with sulphate of ammonia. Three plats received no manure.

Data relative to the yield of cotton at each picking and the total yield for each plat, together with field notes on the growth and appearance of the crop, are tabulated for each experiment. The results were quite pronounced in favor of the use of special fertilizers in about one third of the trials, and in several others they were suggestive. Thus, on eight fields the indications were that nitrogen and phosphoric acid were the elements most needed for the production of cotton; on two, phosphoric acid alone; on two, potash and nitrogen; and on four, all three elements.

For comparison, the results are given of the experiment at the college on the same plan, reported in Bulletin No. 22 of the station (See Experiment Station Record, Vol. II, p. 548).

Considerable interest in the experiments is reported to have prevailed among the farmers throughout the counties in which they were made.

A list is given of the 42 farmers taking part in the co-operative experiments in 1891, brief notes on the soils represented, and directions for carrying out the tests.

REPORT OF THE ALABAMA WEATHER SERVICE FOR JANUARY, 1891, P. H. MELL, Ph. D., AND J. M. QUARLES (pp. 62–64).—Notes on the weather, and a tabulated monthly summary of meteorological

observations and of soil temperatures (taken by A. M. Lloyd) at depths of from 1 to 96 inches below the surface.

Alabama College Station, Bulletin No. 24 (New Series), February, 1891 (pp. 16).

DAIRYING AND BREEDING, ISAAC ROSS (pp. 3–11).—This is a popular discussion on the "model dairy cow," on methods and rules for breeding, feeding, and care of animals, and on butter making, prepared for the farmers of the State.

REPORT OF THE ALABAMA WEATHER SERVICE FOR FEBRUARY, 1891, P. H. MELL, PH. D., AND J. M. QUARLES (pp. 12–16).—Notes on the weather, and a tabulated monthly summary of meteorological observations and of soil temperatures (taken by A. M. Lloyd) at depths of from 1 to 96 inches below the surface.

Connecticut State Station, Bulletin No. 107, April 15, 1891 (pp. 6).

THE CONNECTICUT SPECIES OF GYMNOSPORANGIUM (CEDAR APPLES), R. THAXTER, PH. D.—Seven distinct species of *Gymnosporangium* have been found in Connecticut—"two upon the white or swamp cedar (*Cupressus thyoides*) neither of which is economically important, one peculiar to the common juniper (*Juniperus communis*), three upon the red cedar (*J. virginiana*), and one occurring on both the last-named plants; the last five species all possess more or less economic interest from the rusts which they are likely to produce."

The writer has continued experiments on all these species for the past 5 years, and has succeeded by artificial cultures under test conditions in connecting all but one of them (*Gymnosporangium ellisii*) with its proper rust, making at the same time a critical study and comparison of the different forms and stages. In a paper on the subject (published in the Botanical Gazette, Vol. XIV, No. 7), attention was called (pp. 169 and 172, note) to the fact that the so-called bird's nest *Gymnosporangium* of the red cedar, which had hitherto been confused with another American (*G. clavipes*), as well as with a European species (*G. conicum*), was shown by cultures made at this station and at Cambridge, as well as by observations made in the vicinity of New Haven, to be a distinct and peculiarly American form. * * * Experiments performed by the writer before he became connected with this station have been repeated here in the case of *G. macropus*, *G. globosum*, *G. biseptatum*, and *G. clavariæforme*, the failure of cultures with *G. ellisii* on the two occasions when they were attempted having been directly traceable to the use of teleutospores, which were not in good condition for cultures, the species not being readily obtainable in a fresh state. In the case of *G. macropus*, *G. clavariæforme*, and *G. biseptatum* results were obtained identical with those previously published by the writer; while in the case of *G. globosum* certain additional facts were ascertained, namely, that perhaps the most common orange rust of apples in this State is undoubtedly caused by this species. This rust, which has been referred to in previous papers as "*lacerata z*," was induced by inoculation with sporidia from *G. globosum* on three seedling russets, the inoculation being made in the greenhouse by forcing the cedar apple, as well as its host, so early in the spring that all possibility of accidental mixture was avoided. Spermogonia appeared the first week in April, the infection having been made late in March, and perfect and typical æcidia were developed early in July. In addition to

the cultures of *G. globosum*, which were made on these apples, two plants of the mountain ash (*Pyrus americana*) were inoculated with the same *Gymnosporangium* in April, and having produced luxuriant spermogonia, gave abundant and well-developed æcidia late in July. It may be mentioned in passing that these æcidia were not the *Ræstelia cornuta* which occurs on the same host further north, but had all the characters of the *Ræstelia*, which follows inoculation by *G. globosum* on other hosts. In addition to the above facts it was ascertained that a rust of quinces and of Keiffer pears was referable to the same source, both hitherto unrecorded hosts for this species. Cultures of *G. globosum* on hawthorn (*Cratægus crus-galli*) were also repeated and produced abundant and well-developed æcidia under equally strict conditions, confirming the writer's previous statements in all respects.

A brief account is given of the author's observations of the "bird's nest" *Gymnosporangium*, and the new species is described as follows:

Gymnosporangium nidus avis, n. sp.—Sporiferous masses when young, cushion-like, irregularly globose or oval, small and distinct or elongate and confluent according to the habitat, rich red brown, when mature indefinitely expanded by moisture, orange-colored. Teleutospores two-celled, irregular in shape, broadly ovate to sub-elliptical or fusiform, bluntly rounded or slightly tapering towards the apex, symmetrical or often slightly bent. Average dimensions 0.055×0.025^{mm}. Promycelia several, not uncommonly proceeding from either extremity. Pedicels when young often more or less inflated below the spore. Mycelium perennial in leaves, branches or trunks of *Juniperus virginiana* very commonly inducing a "bird's nest" distortion.

Ræstelia stage.—Spermogonia yellowish orange, preceding the aecidia by about 10 days. Æcidia hypophyllous or more commonly on petioles, young shoots and especially on young fruit, densely clustered, brown, at first subulate, then fimbriate, the peridia splitting to the base with its divisions slightly divergent. Peridial cells rather slender, the ridges somewhat prominent, sublabyrinthiform, horizontal or becoming inwardly oblique towards the extremities. Average measurements (towards the apex of the peridia) 0.07×0.018^{mm}. Aecidiospores smooth, spherical, or irregularly oval to oblong, average diameter 25^{mm}.

Mycelium annual in the leaves of *Cydonia* (quince) and in leaves, stems, and fruit of *Amelanchier canadensis* (service-berry) in June.

Delaware Station, Bulletin No. 10,* October, 1890 (pp. 32).

INTRODUCTION, A. T. NEALE, PH. D. (pp. 3–7).—Attention is called to some important points connected with the report on the use of fungicides for diseases of the grape, as given in the bulletin.

(1) A vineyard in Delaware, measuring 45,888 square feet, in 1890 yielded a crop which sold for \$933.24. "Of this amount \$710.75 was left after harvesting, shipping, and commission expenses had been paid; this is equivalent to \$674.30 per acre." Good management of the vineyard, neatness in preparing fruit for sale, and business ability in finding and holding a first-class market, can account for only a portion of this profit; the rest seems to have been due to the use of fungicides, which prevented the black rot from ruining the fruit.

(2) "The method of leaving a few unsprayed trees in the center of a vineyard to represent what the vineyard would yield if the black rot

* Bulletin No. 9 has not yet been issued.

were left unchecked, is fallacious, and tends to depreciate the importance of the Bordeaux treatment."

(3) The first applications of fungicides may destroy the disease already present; subsequent applications prevent its invasion. The experience of the station in experiments in different vineyards is cited to show this.

(4) Experiments by the station corroborate those of French investigators, in demonstrating that anthracnose, as well as black and bitter rot and mildew, "may be held in check by the Bordeaux mixture and also by a cheaper preparation, viz., carbonate of copper."

(5) As regards the effect of the fungicides on the marketable quality of the fruit, the grower can be guided by his eye as long as he uses the Bordeaux mixture. If the grapes are much stained they should be washed with a very dilute mixture of vinegar and water; "but if any salt of copper comes into use which protects the grapes without causing stains, then chemical tests must determine whether the grapes carry copper in quantity exceeding that found in ordinary healthful food."

DISEASES OF THE VINE CONTROLLED BY SEVERAL DIFFERENT SALTS OF COPPER, F. D. CHESTER, M. S. (pp. 8-32).—This includes a report on experiments with fungicides for black rot and anthracnose. Directions for preparing and applying the fungicides used in these experiments, the wholesale prices of materials, etc., are also given.

Experiments at Smyrna.—These were in the vineyard of L. E. Anthony, and were a repetition of those of 1889, reported in Bulletin No. 6 of the station (See Experiment Station Record, Vol. I, p. 195). "In both cases the Bordeaux mixture was used upon the entire vineyard with the exception of certain check rows left unsprayed." A diagram of the vineyard is given. April 11, 1890, the vines were washed with a solution of copper (1 pound to 25 gallons of water). This is known as the "winter treatment." Bordeaux mixture was applied four times between May 7 and June 27. The fifth spraying, July 21 and 22, was made with the carbonate of copper and carbonate of ammonia mixture. In 1889, when only the Bordeaux mixture was used, the fruit was badly stained, but in 1890 only a few hundred pounds were sufficiently stained to require washing. "Even this, the writer believes, could have been avoided by making the applications of the Bordeaux mixture lighter." August 1, the diseased fruit was picked and the loss due to the rot was calculated. "For the unsprayed vines the loss by rot was approximately 16 per cent; for the sprayed vines approximately one half of 1 per cent." In 1888, owing to the ravages of black rot, only 250 pounds of grapes were harvested; in 1889 the vines were sprayed with Bordeaux mixture and yielded 2,953 pounds of grapes, or 2.72 pounds per sprayed vine; in 1890, with the treatment indicated above, 7,451 pounds of grapes were harvested from the sprayed vines, or at the rate of 8.47 pounds per vine. The net receipts from 7,451 pounds of grapes produced by the treated vines was

$560.90; the cost of spraying was $27.80, leaving a net income of $533.10.

Details of the experiment are given in notes and tables, and the results are thus summed up:

(1) As a result of two years' treatment in a vineyard previously well-nigh ruined through the ravages of black rot, the yield has been raised to the normal of 8.47 pounds per vine, and the percentage of rot reduced to about one half of 1 per cent.

(2) The net income per vine was 75 cents, and the cost of treatment 3 cents, leaving a net balance of 72 cents per vine.

(3) A few check unsprayed rows left between a majority of others which are sprayed fail to become a measure of the loss in an untreated vineyard.

Experiments near New Castle.—These were on Champion grapes in the vineyard of Dr. J. J. Black. The fungicides used were ammoniacal carbonate of copper, carbonate of copper and carbonate of ammonia mixture, precipitated carbonate of copper, and Bordeaux mixture. A diagram illustrates the location of the sections of the vineyard where the different fungicides were used. Anthracnose was the prevailing disease, but there was also a certain amount of black rot. April 12 a part of the vines were sprayed with a solution of sulphate of copper (1 pound to 20 gallons of water). Five applications of the different fungicides were made between May 17 and July 18. "The last application to vines sprayed with the Bordeaux mixture was made with the carbonate of copper and carbonate of ammonia mixture. As a result, it was not found necessary to wash any of the fruit at harvest." One day previous to harvesting the crop the diseased berries were picked and weighed. A table shows the results for each kind of treatment. The percentage of diseased fruit varied from 29.2 on the unsprayed vines to 1.9 where the Bordeaux mixture was heavily applied; the yield per vine ranged from 1.12 pounds for the unsprayed vines to 4.5 pounds where the Bordeaux mixture was heavily applied. The results of the experiment may be summed up as follows:

(1) The winter treatment of these vines with sulphate of copper has been highly beneficial, the percentage of diseased fruit being nearly twice as great on vines which did not receive this treatment as on those which did, while the yield by the winter treatment was increased about 1 pound to the vine.

(2) In this experiment the ammoniacal carbonate of copper has not given satisfactory results.

(3) The carbonate of copper and carbonate of ammonia mixture, combined with the winter treatment [was cheaper and more effective], * * * yet it is questionable whether even this mixture is to be generally recommended.

(4) The precipitated carbonate of copper is nearly as effectual in preventing rot and anthracnose as the Bordeaux mixture, and on account of its cheapness promises much.

(5) The Bordeaux mixture has produced the best results; not only by diminishing the rot and anthracnose, but by apparently stimulating the growth and vigor of the vines.

(6) According to this experiment a light spraying of the Bordeaux mixture is nearly as effectual as a heavy spraying.

Experiments near Newark.—These were on Concord grapes in the vineyard of the Randolph Peters' Nursery Company, where the conditions were particularly favorable to the rot and other diseases. The plan of the experiment is shown in a diagram. In addition to the fungicides used in Dr. Black's vineyard, a modified eau celeste and mixture No. 5, U. S. Department of Agriculture, were applied to certain vines. Six applications were made between May 10 and August 7.

In order, as before, to avoid the necessity of washing the fruit sprayed with the Bordeaux mixture, the last two sprayings of these vines (on July 21 and August 7) were made with the modified eau celeste. Owing also to the previous scorching of the foliage by the sulphate of soda in the precipitated carbonate of copper, it was decided to discontinue the original form of this mixture, and accordingly at the last two sprayings the second form of the mixture was used, by adding to each 25 gallons of water 1 pound of the dry carbonate of copper, and a solution containing 3 ounces of common glue. The addition of a small amount of glue to the mixture caused a remarkable adherence of the fluid to the berries, which was not the case when the glue was omitted.

A table shows the result for each kind of treatment. The percentages of diseased fruit varied from 46.5 for one row of the unsprayed vines to 2.3 where the precipitated carbonate of copper was used, with the winter treatment. The yields per vine were quite irregular, probably due to the neglected state of the vineyard. The results of this experiment may be summed up as follows: The ammoniacal carbonate of copper and the carbonate of copper and carbonate of ammonia mixture did not give satisfactory results. "The precipitated carbonate of copper, Bordeaux mixture, modified eau celeste, and mixture No. 5, U. S. Department of Agriculture, were all effective fungicides in protecting the vines from rot. From the point of protection from rot the precipitated carbonate of copper takes the lead, but, all things considered, the Bordeaux mixture seems to have done better work by apparently stimulating the growth of the vines. Unsprayed rows left between a majority of others which are sprayed fail to become a measure of the loss in an untreated vineyard."

With a view to studying the progress of the disease during the season of 1890, bags were put upon twenty-five clusters of grapes each week, from May 22 to August 4. On September 2 all the bags were opened and the diseased and healthy berries in each lot counted. The results, as indicated in a table and diagram, indicate a period of great infection between June 5 and 14, and a second infection between July 3 and 11. In the first case the weather was favorable to the progress of the disease, but in the second case the attack can not be explained by the meteorological conditions.

Directions for preparing and applying the fungicides used in these experiments, wholesale prices of materials, etc.—The methods used in preparing the six different fungicides used in the experiments reported in this bulletin, are described.

The cost of the materials in 100 gallons of each of the fungicides is

reckoned as follows for 1890: "carbonate of copper and carbonate of ammonia mixture 25¼ cents, precipitated carbonate of copper 34 cents, modified eau celeste 40 cents, ammoniacal carbonate of copper 57¾ cents, Bordeaux mixture $1.51, mixture No. 5 $1.35.

Spraying apparatus is described and discussed, with illustrations.

The following is a general résumé of the experiments of 1889 and 1890:

(1) In cases where vineyards have become seriously affected by disease so that it is necessary to use heroic measures, the Bordeaux mixture or the carbonate of copper in suspension in water, with glue, offer the most promising results. The latter on account of its cheapness has points in its favor.

(2) The carbonate of copper and carbonate of ammonia mixture (B) is to be preferred to the ammoniacal carbonate of copper (A) and may be used for the last application, where the Bordeaux mixture is previously applied, in order to overcome the necessity of washing the fruit; or it may be used with the winter treatment for all applications in vineyards in which the rot has been reduced to a minimum by one or two years' treatment with stronger fungicides.

(3) The modified eau celeste and mixture No. 5, U. S. Department of Agriculture, are effective fungicides, but on account of their tendency to scorch the foliage, are open to objection.

(4) Where the Bordeaux mixture is used, the last application with this mixture should be light, and the final application should be made with either the carbonate of copper and carbonate of ammonia mixture or with the modified eau celeste.

(5) In using the Bordeaux mixture it is not necessary to plaster the vines. One gallon to every five vines of average size is sufficient.

(6) The cost of application where the Bordeaux mixture is used need not exceed 3 cents per vine for the season, and with greater economy in the use of the material this can be reduced.

(7) By the use of the carbonate of copper in water, the cost of treatment can be diminished about one half, but as this item is small compared with the value of the fruit, it is questionable whether it would be justifiable to select the cheaper mixture until further experiments have been made.

(8) Complete annihilation of rot in a vineyard can not be expected from one year's treatment, but may be assured as a result of persistent effort.

(9) Anthracnose can be controlled with either the Bordeaux mixture or the precipitated carbonate of copper.

(10) The nozzle to be used in applying fungicides should throw a misty spray, and the nearer it approaches this the better.

(11) Wet every part of the vine, but avoid unnecessary waste of material.

(12) The pump should have the parts that come in contact with the fungicides made of brass, and should give a strong and steady pressure.

(13) The receptacle for holding the fungicide should be of liberal size, and should be drawn by a horse.

(14) For diseases of the grape, spray the vines before the buds swell with a solution of sulphate of copper—1 pound of the sulphate to 20 gallons of water. Make the first application the middle of May, then every two weeks for five or six applications.

Delaware Station, Bulletin No. 11, January, 1891 (pp. 15).

SOIL AND CROP TESTS, A. T. NEALE, PH. D.—This is an account of preliminary experiments to test the practical value of co-operative field experiments and to demonstrate their value as "object lessons."

The experiments included fourteen separate trials in three counties of the State, six being with corn, three with sweet-potatoes, two with peach trees, two with strawberries, and one with tomatoes.

Corn.—An acre of land was used for each trial, and was divided into sixteen plats in three cases, and into ten plats in the three remaining cases. Nitrate of soda, muriate of potash, and acid phosphate, in amounts not reported, were used singly, two by two, and all three combined, a variable number of plats receiving no fertilizer. Unfavorable conditions rendered the results of two trials of very little value, "but in no case in any of the six tests was any positive proof gained that the increased corn crop paid for the use of the fertilizer. * * * The experiments demonstrated that a large excess of the highest grade of plant food can be used without results, even on fields which have been prepared, seeded, and cultivated with special care."

Sweet-potatoes.—In the three trials with sweet-potatoes nitrate of soda 160 pounds, acid phosphate 400 pounds, and muriate of potash 160 pounds were used alone and combined, and several plats remained unfertilized. "In every case very marked profits were secured from fertilizers," but "one plat tells a story which the adjoining plat contradicts," and "no clear explanation as to the manner in which the fertilizers work is at hand." Only one of the three trials furnished definite indication as to the soil for this crop. Two trials were also made to determine whether scarlet clover turned under as green manure could take the place of nitrate of soda. Acid phosphate and muriate of potash were used alone and combined. One trial was seriously affected by insects. In the other trial "the results were favorable to the clover." The plat receiving muriate of potash, acid phosphate, and a green manuring with clover yielded 228 bushels per acre of sweet-potatoes, a gain of 18 bushels over the adjoining plat (belonging to the previous experiment), which received nitrate of soda in place of the green manuring.

Peach trees.—The two trials were on 144 two-year-old trees, 12 trees in each plat, and "the effects of fertilizers were measured solely by the growth of new wood." The same fertilizers were used as in the previous experiment, with the addition of gypsum; the amounts applied are not stated. In one experiment the largest growth was with nitrogen, and in the other with phosphoric acid or with phosphoric acid and nitrogen combined.

Strawberries.—The plants were injured by the fertilizers used and by the white grub, and no results were obtained the first year.

Tomatoes.—The fertilizers used in the single experiment with tomatoes were the same as in the trials with corn. The land used had been in alfalfa and red clover the year before, and "a medium sod was turned under for the tomatoes." The results were inconclusive for any single material. The largest yield was with acid phosphate and muriate of potash combined. "Neither alone nor in combination with phosphoric acid and

potash did the nitrate prove that it caused an increase sufficient to pay for its purchase and use." The author suggests that the previous crop "doubtless afforded a rather large supply of nitrogen, and rendered useless the application of nitrate of soda."

"The State Grange has asked to have these experiments continued next year. If they are regarded as object lessons land owners and fertilizer manufacturers will both profit by the work."

Delaware Station, Bulletin No. 12, March, 1891 (pp. 28).

INJURIOUS INSECTS AND INSECTICIDES, M. H. BECKWITH (illustrated).—Notes on the black peach aphis (*Aphis persicæ-niger*), spring canker-worm (*Paleacrita vernata*), rose-chafer (*Macrodactylus subspinosus*), harlequin cabbage bug (*Murgantia histrionica*), cut-worms, and angoumois grain-moth (*Sitotroga cerealella*), with suggestions as to remedies, and brief accounts of experiments with insecticides. Kerosene emulsion was successfuly used for the black peach aphis and rose-chafer, as well as for the black flea beetle (*Crepidodera cucumeris*). Tabulated details are given for an experiment in which 16 apple-trees were treated with London purple and 18 with Paris green for the codling moth. The best results were obtained by spraying three times, using the arsenites at the rate of 1 pound to 200 gallons of water, under which conditions there was practically no difference in the effectiveness of the two insecticides. Brief directions are given for the use of London purple, Paris green, white hellebore, kerosene emulsion, and tobacco decoction. Spraying machinery is described and illustrated.

Iowa Station, Bulletin No. 12, February, 1891 (pp. 58).

EXPERIMENTS WITH POTATOES, R. P. SPEER (pp. 507–518).—Brief accounts are given of field and greenhouse experiments with whole potatoes, pieces of different sizes, "nubs," and immature potatoes as seed. Analyses by G. E. Patrick, M. S., the station chemist, as tabulated, show a larger amount of albuminoids in the seed ends than in the stem ends of potatoes, and in ripe than in unripe potatoes or nubs. The experiments and analyses enforce the importance of selecting mature potatoes of good size and quality for seed.

SUGAR-BEETS, G. E. PATRICK, M. S., AND E. N. EATON, B. S. (pp. 519–529).—The experiments in 1890 were in continuation of those reported in Bulletin No. 8 of the station (See Experiment Station Record, Vol. II, p. 54). Tabulated data, including description of samples, reports on soil and culture, per cent of sugar (sucrose) in beets and in juice, purity co-efficient, etc., are given for 34 samples of sugar-beets grown at the station and elsewhere in Iowa. Only five of the samples contained more than 13 per cent of sucrose, while eight contained over 12 per cent. Analyses of 14 samples received from Nebraska are also given. These averaged 13.2 per cent of sucrose in the beets. With a

view to further experiments in Iowa by the station in co-operation with farmers, directions are given for the culture of sugar-beets.

SORGHUM, G. E. PATRICK, M. S. (pp. 530–533).—"Work aiming at improvement of the sorghum plant by seed selection based upon analysis of individual canes, begun in 1888 and continued in 1889, with the results reported in Bulletins Nos. 5 and 8 [See Experiment Station Record, Vol. I, p. 44, and Vol. II, p. 54], was again continued last year (1890). In accordance with the plan of work, seed from only such stalks of 1889 as were among the highest in sugar content was planted. Soil and culture were nearly the same as in previous years, both supposed to be good."

The crop was seriously injured by drought, so that as regards the amount and quality of the juice the results were not as good as those of the previous year. "In percentage of sugar in the juice there was on the average but a trifling decline, and in quite a number of cases an appreciable advance, chiefly in canes growing on higher ground." Out of 179 stalks of Early Amber sorghum analyzed the analyses of the 10 yielding the highest percentage of sucrose, as tabulated, showed an average purity of 73.4, with a mean sucrose content of 14.88 per cent. The averages for the 179 canes were, purity 69.52, sucrose 13.05 per cent.

The results of 1889 and 1890 are compared as follows:

Early Amber.		Season.	On the juice.		
			Solids, Brix.	Sucrose.	Purity.
			Per cent.	*Per cent.*	
Average of 20 stalks showing highest sucrose		1889	18.66	14.26	76.45
		1890	20.14	14.69	72.97
Average of 20 stalks showing lowest sucrose		1889	16.80	11.47	68.24
		1890	17.43	11.22	64.36
Average of all individual canes analyzed	140	1889	17.80	13.18	74.04
	179	1890	18.77	13.05	69.52

A variety of Early Amber grown from seed received from Minnesota matured about a week earlier than the station cane planted at the same time, but in analyses of 60 stocks of this variety the per cent of sucrose averaged only 10.64 and the purity co-efficient 61.47.

INSECTS AND INSECTICIDES, C. P. GILLETTE, M. S. (pp. 535–549).—This includes a brief description of a caterpillar observed by the author as infesting clover at the station and at Champaign, Illinois; an account of experiments with hellebore, "peroxide of silicates," and Paris green for the cabbage-worm (*Pieris rapæ*); notes on the following species of cut-worms observed at the station during the past 3 years: ***Agrotis messoria*, *A. tessellata*, *A. subgothica*, *A. tricosa*, *A. ypsilon*, *A. saucia*, *A. c-nigrum*, *A. bi-carnea*, *A. clandestina*, *A. badinodis*, *A. velleripennis*, *A. auxiliaris*, *A. mercenaria*, *A. venerabilis*, *A. brunneicollis*, *A. gladiaria*, *A. 4-dentata*, *A. suffusa*, *Mamestra renigera*, *Hadena devastatrix*, *H. sputatrix*, *H. lignicolor*, *H. stipata*, *Nephelodes violans*,** and

Leucania unipuncta; brief breeding-cage notes on the food habits of cut-worms; a statement of the results of experiments with various insecticides for the striped cucumber beetle (*Diabrotica vittata*); note on the potato stalk-weevil (*Trichobaris trinotata*); and a statement of the results of experiments with a kerosene extract of pyrethrum as an nsecticide.

For the cabbage-worm, hellebore did not prove effective; "peroxide of silicates" was fairly destructive; but the most effectual remedy was a dry mixture of Paris green and flour (1 ounce of Paris green to 100 ounces of flour). An experiment reported in the bulletin indicated that there is very little danger of poisoning from cabbages treated with Paris green.

For the striped cucumber beetle, dry pyrethrum, pyrethrum tea, copperas, carbolic acid, and gas lime were ineffective; nitrate of soda, kerosene, and hellebore repelled the insects for a time; a mixture of Paris green and flour gave fairly good results; fresh wood ashes dusted on the plants after the dew had begun to fall at night proved the most effectual remedy. Open boxes were of no use in fencing out the beetles though the same boxes covered with mosquito netting or cheese cloth are an effectual preventive for the cabbage-worm.

The potato stalk-weevil was observed in abundance in the winter of 1890 in the stems of two species of *Physalis* (ground-cherry) in the vicinity of the station.

In the summer of 1888 the author first made use of a combination of kerosene emulsion and pyrethrum as an insecticide for chinch-bugs. He has since successfully used this preparation for false chinch-bugs (*Nysius angustatus*), cabbage-worms, red spiders, and plant-lice. His first published reference to the matter was in Bulletin No. 5 of the station, May, 1889, p. 184, where he briefly states that a preparation made by diluting kerosene emulsion with pyrethrum tea was used by him for the red spider (*Tetranychus telarius*). An account of experiments at the Arkansas Station with a similar preparation for the cotton boll-worm (*Heliothis armigera*) was published in Bulletin No. 15 of that station (See Experiment Station Record, Vol. II, p. 318).

FEEDING EXPERIMENT, R. P. SPEER (pp. 550–552).—The author states that when large quantities of corn meal are fed to fattening cattle "much of it passes through them undigested." He suggests that cattle could be made to remasticate a large share of it "by mixing meal with cut hay or straw." To test the advisability of this, six calves, from 9 to 10 months old, were fed from February 8 to March 31, 20 pounds of corn-and-cob meal per day, and timothy hay *ad libitum*, the meal being fed dry to one half the calves about an hour and a half before the hay, and to the other half moistened and mixed with the cut hay.

The weights and gains of the animals are tabulated. The three receiving the hay separately gained 227.5 pounds during the trial, and

the three receiving it cut and mixed with the meal, 205.2 pounds. Whether or not the digestibility of the feed was affected by the manner of feeding "it was not possible for us to determine, but the result of the experiment indicates that it is best to feed corn meal and other similar food which does not need remastication, before hay or other coarse fodder, so that it may be allowed to pass to the third apartment of the animal's stomach before the latter enters it."

Kansas Station, Bulletin No. 16, December, 1890 (pp. 17).

EXPERIMENTS WITH SORGHUM AND SUGAR-BEETS, G. H. FAILYER, M. S., AND J. T. WILLARD, M. S. (pp. 135–149).—The experiments with sorghum were in continuation of those reported in the Annual Reports of the station for 1888 and 1889 (See Experiment Station Record, Vol. II, p. 339). The climatic conditions in 1890 were unfavorable to the growth of sorghum or sugar-beets. The deficient rain-fall and intense heat of the early summer were followed by cool, wet weather, culminating in an unprecedented killing frost, September 13. "This frost was so exceptional as to date and so erratic in distribution, its limits bearing no relation to isotherms or latitude, that it gives no ground for the conclusion that we are too far north for successful sugar manufacture from sorghum."

Sorghum, comparison of varieties (pp. 135–140).—Tabulated data on the samples taken for analysis and on the results of the analysis are given for twenty-one of the older varieties and for some thirty (principally foreign) varieties grown from seed derived from that sent to the station by P. Collier, Ph. D., in 1889. Notwithstanding the unfavorable climatic conditions the standard varieties showed a good, though lower sugar content.

Sorghum, improvement by seed selection (pp. 140–143).—Tabulated data are given for analyses of single stalks of eight varieties grown from seeds obtained from the best stalks in 1889; and for analyses of thirteen varieties grown from selected seed obtained from Sterling, Kansas. The results of the station's experiments in seed selection of sorghum for the past three years (1888–90) are also summarized in a table. The results in 1890 were as a rule inferior to those of previous years, but on the whole the experiments thus far made "lend encouragement to the hope that the standard of sugar content may be permanently raised by this means."

Sorghum, trial with fertilizers (pp. 143, 144).—Permanent plats were staked off in 1890 for a series of experiments with a view to improving sorghum by the use of fertilizers and thorough cultivation. Lime, superphosphate, nitrate of soda, sulphate of potash, and gypsum were used singly and combined in a "complete" fertilizer. Tabulated results of analyses of sorghum from each of the plats are recorded, but owing to the unfavorable climatic conditions the experiments are not considered satisfactory. They will be continued.

Sorghum, crossing of varieties (p. 144).—Tabulated results are given of analyses of sorghum grown from crosses selected in 1889. A comparison with the varieties from which they sprung indicates deterioration as the result of the crossing.

Sorghum, injuries by smut (p. 145).—"Several varieties grown by the department for the first time in this country were found to be badly infected by a smut which, while not changing the appearance of the seed top to a great extent, completely destroys the infected grains. They become considerably enlarged and in many cases burst, allowing the black spores to escape. This grain smut of sorghum has also been observed here upon sorghum grown by the farm department. In addition to this we have observed a single example of a smut which in general appearance closely resembles the ordinary smut of corn, the grains being enormously enlarged and converted into a loose black powder. This occurred in a plat of African or Liberian sorghum."

Sugar-beets, analyses (pp. 145–149).—Tabulated data are given for analyses of sugar-beets of several varieties grown at the station in 1890. As compared with results obtained in other parts of Kansas and in Nebraska, the sugar content of the beets tested at the station was relatively low. "This may have been due to the unusually unfavorable climatic conditions of last summer or to unsuitable soil. Analysis of individual beets indicated that maturity, more than size, determined the sugar content of the beet. A brown epidermis accompanied high per cent of sugar. As far as our observations went, a high weight of leaves as compared with the roots, was no evidence of high sugar content, but rather the reverse."

Kansas Station, Bulletin No. 17, December, 1890 (pp. 24).

CROSSED VARIETIES OF CORN SECOND AND THIRD YEARS, W. A. KELLERMAN, PH. D., AND W. T. SWINGLE, B. S. (pp. 150–174, illustrated).—This is a continuation of experiments previously reported in the Annual Reports of the station for 1888 (See Experiment Station Bulletin No. 2, Part II, p. 35) and 1889 (See Experiment Station Record, Vol. II, p. 343).

In 1888, 41 varieties were used. The number of cases of cross-fertilization attempted was 66, of which 39 were unsuccessful. Of the latter, 23 were planted in 1889, and the results obtained were published. Some of the ears were used as seed this year (1890), and the results of this planting are given in the bulletin. In 1889 artificial crosses were made with 56 varieties. Crossing was attempted in 188 cases, and of these 175 were successful. Many of the latter were planted in 1890, with the results as given in this article.

A list of the varieties used in these experiments is given.

Crossed corn the second year.—

About 121 of the "crosses" obtained the previous year (1889) were planted on upland soil in a young orchard May 3–7, 1890. The seed germinated satisfactorily, and the plants grew well until they were injured or killed by the severe drought.

Those not killed were injured to such an extent that scarcely a well filled ear of large or normal size was obtained. For this reason notes as to habits of growth, character of stalks, time of ripening, etc., are not given.

The ears from which the descriptions were prepared were inclosed before the silk appeared. Upon maturity of the pistils (silk) and anthers, some tassels were also inclosed for the purpose of securing pure pollen. The latter was applied to the silk of the inclosed ears, according to the method of pollinating employed in the preceding years. The pollen of each variety was applied to the ears of the same variety, thus insuring pure ears, *i. e.* ears with grains in no case vitiated with any cross.

Of the 62 "crosses" harvested, 5 were too imperfect for comparison. Of the remaining 57, 43 (75.44 per cent) showed evidence of the cross, *i. e.* were intermediates (8 of them in color only) between the parental types. In the previous (first) year but 15 (26.32 per cent) of them showed evidence of cross. The tabulation below shows fully the classified results, and for comparison the record for the first year (1889) also is shown:

Character of cross.	1890. Number of crosses.	1890. Evidence of cross	1890. Doubtful evidence.	1890. No evidence	1890. Supposed previous cross.	1889. Evidence of cross	1889. Doubtful evidence.	1889. No evidence.	1889. Supposed previous cross.
Dent crossed with dent ...	37	* 23	9	3	4	† 13	7	16	4
Flint crossed with dent ..	13	13	......	......	......	‡ 2	1	10	......
Dent crossed with flint ..	2	2	......	......	......	......	1	1	......
Flint crossed with flint ..	1	1	......	......	......	......	1	......	......
Soft crossed with dent ...	3	3	......	......	......	......	......	......	......
Dent crossed with soft ...	1	1	......	......	......	......	......	......	......
Totals	57	43	9	3	4	15	10	27	4

* Eight of them in color only. † Seven of them in color only. ‡ One of them in color only.

It was noticed that the more inferior ears mostly failed to present the blending of the two parental types to that degree which better ears usually did. In some cases the parents were but slightly dissimilar, thus rendering the judgment uncertain as to evidences of cross. The blending in some cases was complete and the resulting ears were exactly intermediate in character. The flint character, however, is usually very marked in the second-year ears, whether the dent parent be the male or the female.

Of the crosses made in 1889 simply to improve varieties, all were planted, but only 22 arrived at maturity. * * *

Because of almost complete failure of the corn crop this season, it is evident that no comparison of significance can yet be made between the forms obtained by the crosses indicated above and the varieties whose improvement by the crossing was attempted. However, the seed is not contaminated by unknown pollen, and therefore a continuation of the experiment is possible and is contemplated.

Brief descriptions are given of each of the ears obtained as the result of the crossing, and six of these ears are illustrated in a plate.

Crossed corn the third year.—

Seed selected from the second-year crossed corn (of 1889) was planted on May 10 in a young orchard on rich creek bottom-land. From each "cross" of 1889 the most diverse kernels were selected and planted; especial care was taken to select also any intermediate kernels that seemed likely to furnish a valuable variety. The germination in all cases was good, and for a month or more after planting the growth was all that could be desired. A very severe drought followed, however, which greatly injured all of the crosses planted. In many cases scarcely a single ear was produced, and none of the crosses produced good ears.

Several ears from each plat were inclosed in cloth sacks and were fertilized with pollen from several plants in the same plat. Usually the ears were pollinated from two to four times; because of the drought many of these ears failed to produce a single grain.

A list of the forty-one kinds of crossed corn planted is given, with brief descriptions of the ears obtained in 1890.

Practical summary.—The general indications from the experiments of the three years are thus summed up:

Numerous crosses between varieties of maize by means of artificial pollination were mostly successful, the different races (as dent, flint, soft, sweet, and pop-corn) crossing apparently with equal non-resistance.

The effects of the crossing are in comparatively few cases (mostly in sweet varieties) visible the first year. The second year (or second generation) generally shows ears more or less completely blended, often exactly intermediate between the two parental types; more rarely the grains of a single ear are unlike each other, and each may resemble closely or remotely either parent. The product of the third year is generally true to the seed planted (as shown by record of this year only); by selecting diverse grains from any ear or from different ears, ears are obtained with grains usually like those planted. Any desired form of a "cross" can therefore apparently be perpetuated.

In view of the above, it is possible to effect desired points of improvement in varieties by crossing (and of course fixing or perfecting by subsequent selections). But the experiments were much reduced in value the past season by reason of serious drought. Favorable seasons will doubtless furnish more favorable, or at least more conclusive results in the efforts to improve varieties.

Kentucky Station, Bulletin No. 33, April, 1891 (pp. 15).

FIELD EXPERIMENTS WITH FERTILIZERS ON CORN, M. A. SCOVELL, M. S.—These experiments are a continuation of those begun two years ago, and were made on the same plats. For a description of the land used (a "blue-grass" soil) see Experiment Station Record, Vol. II, p. 143. "The season was unfavorable to corn."

Effect of the leading elements of plant food used in various combinations, on the production of corn.—This is a report of the third year's experiment on this subject. The results of the two previous years are recorded in Bulletins Nos. 17 and 26 of the station (See Experiment Station Record, Vol. I, p. 61, and Vol. II, p. 143). The fertilizers used on the 9 tenth-acre plats were nearly the same as in 1889, *i. e.* nitrate of soda, muriate of potash each 160 pounds per acre, dissolved boneblack, and acid black 320 pounds, used singly, two by two, and all three together; two plats remained unmanured. In 1889 each plat was divided in two halves to compare the effect of sulphate and muriate of potash; in 1890 the same fertilizers were applied to both halves. "The plats receiving no fertilizers the past years received none this year, and likewise the plats receiving fertilizers during the past years received the same kind in each case this year."

Field notes, the yield of corn and fodder, and the financial results are given for each plat. The yields of ear corn on the two unmanured plats were respectively 34 and 40 bushels per acre; on the three plats

receiving fertilizers containing no potash, from 33 to 36 bushels; and on those receiving potash fertilizers, from 65 to 76 bushels, the largest yield being with the combination of potash and nitrogen.

(1) In those plats where potash was one of the ingredients of the fertilizers used there was a marked increased yield [ranging from 28 to 39 bushels of corn per acre] both in corn and fodder.

(2) Where a fertilizer was used without potash there was scarcely any increase in yield over those plats containing no fertilizer.

(3) The greatest increased yield was made by using a combination of potash and nitrogen [39 bushels per acre].

(4) The use of muriate of potash alone resulted in a marked increased yield [30 bushels per acre] over the plats receiving no fertilizers.

(5) There was a profit in the use of fertilizers in every instance where potash was one of the ingredients, the largest net profit arising from the use of the mixture of nitrate of soda and muriate of potash.

(6) There was a [financial] loss by the use of fertilizers where potash was not one of the ingredients.

Permanency of effect of fertilizers.—This is a continuation of the experiment commenced in 1888 on 10 tenth-acre plats "to test the length of time potash fertilizers will remain in the soil and still be available as plant food." The subsoil of the land used is stated as being "so retentive as to make the soil deficient in natural drainage. In 1888 a mixture of sulphate of potash 160 pounds, sulphate of ammonia 260 pounds, and dried blood 100 pounds per acre, was applied on eight plats; two were unmanured, and the remaining five received respectively cotton-seed-hull ashes 500 pounds, muriate of potash 200 pounds, sulphate of potash 200 pounds, kainit 800 pounds, and tobacco stems 3,000 pounds per acre (See Bulletin No. 26 of the station, or Experiment Station Record, Vol. II, p. 144).

In 1890 the three plats which had received cotton-seed-hull ashes, sulphate of potash, and kainit in 1889 were left without manure, and the two remaining plats received muriate of potash 160 pounds and tobacco stems 2,000 pounds, respectively. Thus of the eight plats originally fertilized three had received no fertilizers since 1888, three others had received none since 1889, and the remaining two were fertilized each year. According to the tabulated results for 1890 the yields of ear corn per acre ranged on the unmanured plats, from 17 to 30.5 bushels; on the plats unmanured since 1888, from 44 to 51 bushels; on those unmanured since 1889, from 44 to 61 bushels; and on those fertilized in 1890, from 59 (muriate of potash) to 71 (tobacco stems) bushels. "It will be seen that the fertilizers applied in 1888 were of benefit to the crop of 1890."

Relation of fertilizers to shrinkage and the proportion of kernel to corn.—"For the purpose of continuing the study of the above question, the corn [from the nine plats of the first experiment], after being husked and weighed, was spread on the floor of the barn loft and allowed to cure. The loft is well ventilated. After curing it was shelled. The tabulated data for each plat show the number of ears of corn per bushel

of 70 pounds, the weight of corn when husked and again when cured (February 7), and the weight of the shelled corn from 70 pounds of ear corn. The number of ears per bushel ranged from 112 to 125 on the unfertilized plats and where no potash fertilizer had been used, and from 84 to 91 where the potash had been applied. As in the trial in 1889 (See Bulletin No. 26 of the station, or Experiment Station Record, Vol. II, p. 144), no relation was apparent between the fertilizers used and the shrinkage of the corn in curing or the proportion of kernel to corn.

Maryland Station, Bulletin No. 9,* June, 1890 (pp. 15).

COMPARISON OF STRAWBERRIES, 1890, W. H. BISHOP, B. S. (pp. 19–31).—"In testing varieties of strawberries we have used 24 plants of each, set in rows 3½ feet apart, the plants being 18 inches apart in the rows. One half of the plants were kept in hills or stools by cutting off all runners, and the other half were allowed to form matted rows by letting all runners grow after July 10. In the case of a few varieties where only one dozen plants were available, they were grown in matted rows only. The soil was a clayey loam, somewhat mixed with gravel. This season the crop was materially shortened by dry weather."

Tabulated notes are given for 88 varieties and descriptive notes for 18 of these varieties, which "showed decided characteristics. * * * Comparing the results of the two methods of culture, it is found that in nearly all varieties the matted rows gave a larger yield and generally larger fruits."

Brief notes on 26 varieties of strawberries tested on light, sandy soil, are condensed from the report of Mr. R. L. Gulick, East New Market, Dorchester County, Maryland, published in the *Peninsula Farmer* of June 24, 1890. Similar notes are also given for 13 varieties from a report of W. F. Allen, jr., of Wicomico County, Maryland, in the *Salisbury Advertiser* of July 12, 1890. Tabulated data are given for 26 varieties on trial at the station which have not fruited, including the name, place and time of origin, and the parentage, so far as known. The rain-fall for the first six months of 1889 and 1890 is recorded as observed at the station, Washington, and Baltimore.

Maryland Station, Bulletin No. 10, September, 1890 (pp. 16).

EFFECT OF DIFFERENT FERTILIZERS ON WHEAT, A. I. HAYWARD, B. S. (pp. 33–39).—The land used in the experiments reported in this article consists of a clay loam soil with gravelly subsoil, and had received little or no manure. It was well worn and fairly even in fertility. It had been used for raising fodder corn and sorghum in the year 1888, and after the removal of that crop in the fall had been sown to rye. The growth which sprung up after the harvesting of the rye in

* Bulletins Nos. 7 and 8 have not yet been issued.

June, 1889, was plowed under when the land was prepared for wheat in September.

Twenty-three tenth-acre plats were drilled to Deitz or Deitz Longberry wheat October 19, 1889, at the rate of six pecks of seed per acre. The fertilizers used, which were applied April 3, 1890, were dissolved bone-black 350 pounds, dissolved South Carolina rock 365 pounds, muriate of potash 150 pounds, and nitrate of soda 150 pounds or dried blood 180 pounds per acre, used singly on four plats, two by two on three plats, and one form each of the nitrogenous and phosphatic fertilizers, with muriate of potash as a "complete fertilizer," on three plats; Thomas slag 340 pounds, Orchilla guano 365 pounds, sulphate of iron 50 pounds, kainit 512.5 pounds, castor pomace 362.5 pounds, and stable manure 4,800 pounds per acre, applied on one plat each. Seven plats received no manure. "A week after the application of the fertilizers those plats which received nitrogen in the form of nitrate of soda showed a decided change in color of foliage and a rapid growth. The latter was observable throughout the season, and at time of harvest the wheat on plat No. 21 [nitrate of soda, muriate of potash, and dissolved South Carolina [rock was fully 6 inches taller, on an average, than the crops of adjoining plats."

The season was generally favorable and the crop was harvested June 20. The fertilizers applied and yields of wheat and straw per acre from each plat are stated in a table. "The average crop was a poor one, which is believed to be accounted for in part by the late seeding and in part by the general condition of the land, this being its first year with fertilizers." The yield on the 7 unfertilized plats ranged from 9.1 to 13.9, and averaged 12.2 bushels of grain per acre. The 3 plats receiving "complete fertilizer" averaged nearly 18 bushels, a gain of 5.75 bushels over the unfertilized plats. The plat receiving stable manure at the rate of 4,800 pounds per acre produced less than the average of the unmanured plats. The plat on which nitrate of soda, muriate of potash, and dissolved South Carolina rock were applied together yielded 5 bushels more per acre than the adjoining plat where the nitrate was replaced by dried blood, and 6.8 bushels per acre more than the plat where the South Carolina rock was replaced by dissolved bone-black. "It is not to be believed that this difference was caused by the fertilizer, but no satisfactory explanation can be offered. * * * The four plats given phosphoric acid only produced less than any four of the 'nothing' plats. Potash alone did no better. But wherever nitrogen was used there was a decided gain," except on one plat where with nitrate of soda used alone the yield was only 9.6 bushels per acre.

Although "more time must be allowed for the fertilizer to take effect before satisfactory deductions can be obtained from this field," the following generalizations are made: "(1) The use of fertilizers somewhat increased the crop; (2) the greatest increase was where nitrogen, phosphoric acid, and potash were applied in combination; (3) the next best

result was from the use of nitrogen with some other plant food; (4) wherever two forms of plant food were used the result was better than in any case where only one form was applied."

TEST OF VARIETIES OF WHEAT, A. I. HAYWARD, B. S. (pp. 39–46).—Tabulated notes on 45 different varieties of wheat tested on fortieth-acre plats which were cut down to one fiftieth of an acre at the time of harvesting. "The crop as a whole was poor enough, yet better than could be expected from sowing so late [November 6–8]. These conditions did not materially affect the comparison." A drought in June "came too late to seriously injure the crop, but it caused the several varieties to ripen at nearly the same time, whereas there were notable differences of maturity apparent three weeks earlier." The three varieties in all respects superior to the others in this test were the Deitz, Fulcaster, and New Australian, the Deitz leading.

Maryland Station, Bulletin No. 11, December, 1890 (pp. 30).

EXPERIMENTS WITH TOMATOES IN 1890, W. H. BISHOP, B. S., AND H. J. PATTERSON, B. S. (pp. 47–74, illustrated).—The experiments reported in this bulletin were in the main a repetition of those with tomatoes at the station in 1889, a record of which was published in the Annual Report of the station for 1889 (See Experiment Station Record, Vol. II, pp. 348 and 350). The investigations included (1) a variety test, (2) comparison of pot-grown and transplanted plants, (3) fertilizer test, and (4) chemical analyses with reference to the food and fertilizing constituents of tomatoes and the relation of this crop to soil exhaustion.

Tomatoes, test of varieties (pp. 48–56).—In this test 102 lots of seed were used which had been purchased under 80 different names, and included numerous "novelties." Notes on the treatment of the crop are given, together with tabulated data, including a list of the varieties tested, estimated yield per acre, and comparative earliness, with comparisons of pot grown and transplanted plants; and the percentage of flesh and number of cells in the fruit.

Tomatoes, comparison of pot-grown and transplanted plants (pp. 56–58).—The comparison was between tomato plants of some 80 varieties, started in the usual way and transplanted several times, and plants grown in pots and disturbed as little as possible "from the seed to the field."

When the seed was planted, half of each variety was placed in the soil of the hot-bed, and half in 2-inch pots, sunk in the hot-bed soil. When, four weeks later, the one half were "pricked out" and transferred to a cold frame in the usual way, the other half were shifted with great care to 4-inch pots imbedded in the soil of the same frame. As soon as the plants could be well distinguished the number in each pot was reduced to one. When transferring to cold frame, every plant in the bed soil was given a space about 4 inches square. The plants of every variety, potted and bedded, were kept in the same row, in the beds and frames, so as to insure like conditions of growth.

Several warm, wet, cloudy days immediately followed the transfer from hot-bed to

cold frame, and a good many of the transplanted plants were lost by "damping off." No plants were lost from this cause among those in the pots. * * *

When all were placed in the field, the one series were carefully slipped out of the pots and showed no sign of feeling the change; the other series were taken up with all the soil which naturally adhered to the roots, and were set out with somewhat unusual care. In the field the two lots of six plants each of every variety, alike in all respects except the methods of starting, were placed in rows side by side, and thereafter all fared alike. There was a notable difference in favor of the potted plants in starting to grow in the field and in the first blooming.

There were 83 of these variety sets carried through the season with an unbroken record. In 72 cases the yield of the potted plants exceeded the yield of those transplanted. Of the 10 highest yields all but one were from potted plants. Comparing the computed product per acre, the average of the potted plants was 12.78 tons, and of the others 10.76 tons, showing a gain of a little over 2 tons of fruit per acre as apparently due to the pot system of starting the plants. This increase is 18 per cent, and much more than enough to pay for the extra cost of this method. * * * The potted plants, as a whole, produced about twice as much fruit prior to August 15 as did those grown in the usual way. The average was 59 bushels for the potted plants and 30 bushels for those transplanted. Every one of the 20 best early producers shows a greater yield from the potted plants.

Tomatoes, fertilizer test (pp. 58–61).—The plats used in this test were those on which a similar test was conducted in 1889. The varieties planted were "the Ignotum, Queen, and Trophy; the Queen plants were from 4 different lots of seed, and the Trophy from 3 different lots; so the record was kept for these 8 sets of plants (7 each) on every plat separately." Nitrate of soda, dried blood, and dissolved bone-black, singly; and nitrate of soda, dissolved bone-black, and muriate of potash, two by two, and all three together, were used on 10 plats, 2 plats receiving no manure. The yields of each variety are stated in a table.

Tomatoes, chemical analyses (pp. 61–71).—This includes eight tables showing the average composition of tomatoes from the 12 plats differently manured for 1889 and 1890; partial ash analysis of tomatoes from the same plats in 1890; the amount of the different fertilizing ingredients in the total fruit product per acre; a partial analysis of the fruit, vine, and roots of tomatoes; the yield per acre in pounds of the various fertilizing ingredients in the fruit, vine, and roots of tomatoes; the approximate quantities of nitrogen, phosphoric acid, and potash in the product and in the roots and stubble of sundry crops per acre; and the fertilizing components of various farm crops (hay, fodder, straw, grain, meal, vegetables, etc.).

Tomatoes, summary of experiments (pp. 72, 73).—This is by the Director of the station, and includes, among others, the following statements:

In the variety test the range of yield was from 2 to 20 tons per acre, and the average yield was 11.75 tons, or 390 bushels per acre. Selected varieties averaged 14 tons per acre. Ignotum gave the best yield, 19.81 tons, or 660 bushels per acre. The ten best varieties, averaging 18 tons per acre, were Ignotum, Favorite, General McClellan, Early Essex, Large Red, Perfection, Early Smooth Red, Scoville, Trophy, and Table Queen. The best producers during the two years were Ignotum and Favorite. In 1890 the earliest varieties were Hundred Day, Hubbard's Curled Leaf, Ignotum, King of the Earlies, Extra Early Advance, and Early Market Champion. (The list for 1889

was entirely different.) "Novelties" proved no earlier than the older kinds. The greater the number of cells in the tomato, the higher the percentage of solid flesh. An average of 10¾ cells per fruit gives 80 per cent of flesh. Pot-grown plants undisturbed from the seed did not "damp off" as easily as plants bed-grown and transplanted. Pot-grown plants exceeded transplanted plants in product 18 per cent, or at the rate of 2 tons per acre. In earliness or first month of bearing pot-grown plants yielded double the others, a gain of 30 bushels of early fruit per acre.

For quantity of crop tomatoes should be well manured, but it is not well to grow them on the same land successive years. The best crops on fertilizer plats were produced by nitrate of soda, and by a "complete" mixture containing nitrate of soda; in 1889 the result was the same. Better results generally followed the use of two fertilizing elements combined than one used alone, but potash alone as muriate gave good results—better than some mixtures. Phosphoric acid alone had little effect on quantity of crop. Nitrogen in the form of dried blood gave no results. Nitrate of soda and muriate of potash can be recommended as special fertilizers for the tomato. Potash fertilizers seem to decrease sugar and increase acid in tomatoes. Phosphoric acid plats produced some of the sweetest tomatoes found. Nitrogen and potash affect composition of fruit more than phosphoric acid. All three fertilizing elements increase these same elements in the fruit. Phosphoric acid appears to assist most in the use of other plant food already in the soil.

The tomato is not a specially exhausting crop. Tomatoes do not remove as much plant food from soil as most common farm crops at usual rates of product per acre. The refuse of the crop from an acre of tomatoes contains more fertilizing material than similar remains of most other crops. The vines and roots of the tomato are very rich in potash. The residue of the tomato crop should be evenly spread and plowed under. As regards soil economy the tomato crop is a desirable one to raise.

Massachusetts State Station, Circular, April, 1891 (pp. 4).

ANALYSES OF COMMERCIAL FERTILIZERS AND MANURIAL SUBSTANCES SENT ON FOR EXAMINATION, C. A. GOESSMANN, PH. D.—This includes analyses of saltpeter waste, "fish chum," tobacco leaves, fifteen samples of compound fertilizers, and seven samples of bone manures. Trade values for fertilizing ingredients for 1891 are also given.

Massachusetts Hatch Station, Meteorological Bulletin No. 28, April, 1891 (pp. 4).

A daily and monthly summary of observations for April, 1891, made at the meteorological observatory of the station, in charge of C. D. Warner, B. S.

Michigan Station, Bulletin No. 73, April, 1891 (pp. 16).

KEROSENE EMULSION, A. J. COOK, M. S. (pp. 3–7).—A defense of the author's formula for kerosene emulsion.

SOME NEW INSECTS, A. J. COOK, M. S., AND G. C. DAVIS, M. S. (pp. 7–16, illustrated).—Descriptions and illustrations are given of the following insects: Grape phymatodes (*Phymatodes amœnus*, Say); *Meteorus bakeri*, n. s., a parasite on *Hyphantria cunea; Meteorus communis*, Cress., *Mesochorus pulchellus*, n. s., *Ischnocerus nigricapitatus*,

n. s., parasites on *Eufitchia ribearia*, which appeared in Central Michigan in alarming numbers in 1890 for the first time; *Aphidius persiaphis*, n. s., parasite on *Myzus persicæ; Derostenus splendens*, n. s., and *Cratotechus brevicapitatus*, n. s., parasites on *Heterocampa subalbicans; Heydenia unica*, n. s., believed to be the first American species of this genus thus far described.

Michigan Station, Bulletin No. 74, May, 1891 (pp. 6).

FOOT ROT IN SHEEP, E. A. A. GRANGE, V. S.—The author distinguishes two forms of this disease, one of which is contagious and the other sporadic. The symptoms of each form are described, and suggestions are made regarding treatment.

Nebraska Station, Bulletin No. 16, April 15, 1891 (pp. 98).

EXPERIMENTS IN THE CULTURE OF THE SUGAR-BEET IN NEBRASKA, H. H. NICHOLSON, M. A., AND R. LLOYD, PH. D. (illustrated).—This is a second report of progress in experiments with the sugar-beet in Nebraska, and includes a statement of the results obtained in 1890, those for the previous year having been reported in Bulletin No. 13 of the station (See Experiment Station Record, Vol. II, p. 111). The plan of work in 1890 involved the establishment of substations for beet culture at convenient points in different sections of the State, and the co-operation of the county agricultural societies and of a large number of farmers. The substations were located where they could be visited at least once a month by agents of the station, and where individuals could be found who would give the use of land for experimental purposes and cultivate the beets according to the directions issued by the station. Each substation was supplied with a standard rain-gauge and thermometers for air and soil temperatures, and with printed directions and blanks for reporting tri-daily observations. Besides monthly reports on the condition of the work at the substations, the field agents were required to send samples of the soils of the experimental plats to the chemical laboratory of the station. Twenty-five substations formed the visiting circuit of the agents, and more or less regular reports were received from six other substations.

The substations may be roughly grouped into southern, middle, and northern districts.

The southern district includes that portion of the State along the Burlington Railroad south of the Platte River and west of Lincoln.

The middle district comprises that portion of the State north of the Platte River adjacent to the main lines of the Union Pacific and Burlington Railroads west of Grand Island.

The northern district comprises that portion of the State adjacent to the Elkhorn Railroad and west of Norfolk.

The following varieties of seed were imported by the station direct from the growers in France and Germany and used at the substations throughout the State:

Vilmorin, White Improved; Desprez, White Improved; Lemaire, White Improved; and Dippe's Klein Wanzleben.

At each of these substations plats 10 feet square for each variety of seed used were prepared by plowing or spading to a depth of 10 inches.

Notes and tabulated data on the time of planting, the weather during the season of growth, and the average results in weight and sugar content of beets at each substation are given for each of the three districts. The average results from the different districts were as follows:

Statement of averages from the different districts.

Districts.	Weight.	Sucrose.	Purity.
	Ounces.	*Per cent*	
Southern	15.8	14.4	75.8
Middle	19	13.7	82.3
Northern	16.5	13.8	76
Average for whole State	17.1	13.96	78

A comparison of temperatures in Nebraska and Europe is made in the following table:

A comparison of the temperature of Nebraska (average of whole State), expressed in "heat units," with the temperature found by European investigators to be necessary for the production of sugar.*

Months.	Nebraska.		Europe
	1890.	Normal.	
April	1,532	1,132	1,370
May	1,811	1,811	1,840
June	2,160	2,112	1,980
July	2,433	2,347	2,140
August	2,220	2,186	2,030
September	1,908	1,846	1,840
October	1,536	1,556	1,530
Total	13,600	12,990	12 730

* The number of heat units in a month is the product of the daily average of temperature by the number of days in the month.

The sum of the heat units during an average year in this State differs but little from the sum of the heat units required in Europe for sugar production, notwithstanding the fact that the months of June, July, and August are much warmer with us than there.

As a compensation for this excess of heat for these months we have a greater rainfall during these months than does the beet-growing region of Europe, as will be seen from the rain chart of Nebraska and Central Europe [given in the bulletin].

Beet seed was distributed through the county agricultural societies and directly by the station to some 2,000 farmers throughout the State. Nearly 500 samples of beets were sent in to the station for analysis, together with reports on the conditions under which they were raised. These reports and the results of the analyses are summarized in tables, which fill 28 pages. The data include the name and address of the

grower, variety of beet, time of planting and harvesting, kind of soil, amount of cultivation, average temperature, rain-fall, and number of rainy days in each month, from April to November inclusive; weight of sample beets, total solids, per cent of sucrose and glucose, and co-efficient of purity. The statements of 26 individual growers regarding the yield, cultivation, cost, etc., of the crop of beets are given in connection with the tabulated results of the analyses of samples sent in by them. It appears from these statements that in general the beets did not receive that careful and thorough cultivation which is essential to the best results.

Another important statement that is characteristic of these letters, and to which we invite particular attention, is that the beets were the least affected by the adverse season of any crop raised. In this is an important argument for the diversification of farm crops. Here is a crop that is almost certain in a season that is destructive to ordinary grains and grasses. A man who this season has a few acres of beets has that which will enable him to carry his stock through the winter even if his other crops have been almost total failures.

The following table gives the averages in weight, sugar, and purity of the four principal varieties used in the three districts of the State:

Averages in net weight, sucrose, and purity of the principal varieties of beets grown in 1890.

Variety.	Southern district.			Middle district.			Northern district		
	Net weight.	Sucrose	Purity.	Net weight	Sucrose.	Purity.	Net weight.	Sucrose	Purity.
	Ounces.	*Per ct.*		*Ounces.*	*Per ct*		*Ounces*	*Per ct.*	
Klein Wanzleben ...	17	13	80	15.4	13.5	80	15	15.4	80
Vilmorin	14.2	13.3	79	13	15.1	82	16	14.5	75
Desprez............	17	13.5	83	17.7	13.4	82	13	13.7	74
Lemaire......	14.7	13.4	79.3	11.5	14	77	15	14.8	76.5
Averages	15.7	13.3	80.2	14.4	14	80	14.7	14.6	76.4

Considering only the three factors of weight, sucrose, and purity, the Klein Wanzleben and Desprez have given the best average results for the season. * * *

It should be remembered that the season in the northern district was at least two weeks shorter than that in the other districts; that the season in the middle district varied in its meteorological conditions the least of any from the normal, while the southern district had the longest and, comparatively speaking, the most abnormal season.

Another table gives the average number of rainy days in each month from April to November inclusive, for periods ranging from 1 to 13 years, as furnished by the Nebraska weather service for 52 stations in the State.

Insect enemies of the sugar beet (pp. 55–72).—Instructions were issued to the growers at the substations, and especially to the field agents of the station, to make careful observations of all insects feeding on the roots or leaves of the beets, and to send specimens of such insects, with notes on them, to the station. The station entomologist, L. Bruner, reports in this article on the following insects found to be the most

injurious to the beets in 1890, giving accounts of them, together with suggestions regarding their repression: Garden web-worm (*Eurycreon rantalis*), pale-colored flea beetle (*Systena blanda*), triangle flea beetle (*Disonycha triangularis*), striped flea beetle (*Phyllotreta vittata*), *Phyllotreta albionica*, blister beetles, seven species have thus far been observed on beets, of which four are illustrated, viz., *Macrobasis unicolor*, *Epicauta vittata*, *E. maculata*, and *E. pennsylvanica*; true bugs, (four species are illustrated, viz., *Geocoris bullata*, *Piesma cinerea*, *Lygus pratensis*, and *Nysius angustatus*); leaf hoppers (*Agallia siccifolia* in particular); cut-worms of the genus *Agrotis*; wire-worms (*Melanotus communis* is illustrated). Nine of the 23 figures in this article are original.

Cultivation of the sugar-beet (pp. 73–87).—A résumé of the results of European experience, with illustrations of beets grown with and without proper culture and of the implements used in beet culture, by H. E. L. Horton, assistant chemist of the station.

The bulletin also contains general suggestions to farmers regarding the raising of beets for sugar, statements concerning the conditions under which the station will distribute seeds for further tests, and a prospectus issued by the State board of agriculture for a competitive test of sugar-beets raised in Nebraska to be made at the State fair next September.

Nevada Station, Bulletin No. 12, April, 1891 (pp. 9).

SUGAR-BEET CULTURE, R. H. MCDOWELL, B. S.—A brief compilation of information regarding sugar-beet culture, prepared in view of the fact that the station will conduct experiments in that line this season.

New Hampshire Station, Bulletin No. 12, March, 1891 (pp. 13).

FERTILIZER EXPERIMENTS, G. H. WHITCHER, B. S.—The only co-operative experiments carried on under the direction of the station in 1890 consisted of a series of fertilizer experiments with potatoes made on a single farm in the State. The same fertilizers were used on the 20 twentieth-acre plats as in the experiment of 1889, viz., dissolved bone-black, muriate of potash, and sulphate of ammonia, singly and in various combinations on 12 plats; wood ashes, barn-yard manure, and the "prepared fertilizers"—Stockbridge's Potato Manure, Bowker's Hill and Drill, and Bradley's XL—each alone on a single plat; and no fertilizer on 3 plats. The "chemicals" and ashes were applied at the rate of $10 worth per acre, the "prepared fertilizers" at rates varying slightly from this, and the barn-yard manure at about twice this rate. Two tables show the amount and composition of the fertilizer used on each plat, the yield of potatoes, gain over the unfertilized plats, and the value at 50 cents per bushel of the total yield, and the gain for each dollar's worth of fertilizer applied. The yields from the unfertilized

plats, 96, 94, and 92 bushels per acre, indicate that the land selected was quite even in fertility. The largest yield was with barn-yard manure—238 bushels per acre; the average with the "prepared fertilizers" was 178 bushels, varying from 150 to 194; with ashes, 130 bushels; with a single element (either potash or phosphoric acid), 124 bushels; with two elements (potash and phosphoric acid) used together, 206; and the average of various combinations of all three elements, 210 bushels. The author believes that "more potash is needed than the prepared fertilizers furnish." In this experiment the value of the gain in yield from one dollar's worth of fertilizer was with barn-yard manure $3.60, with the complete "chemical" fertilizers $5.80, with the best combination of chemicals $7, and with the "prepared fertilizers" $4.20. No mention is made, however, of the residue of fertilizing materials left in the soil for future crops. The author repeats the conclusions arrived at in previous experiments, that "chemicals when properly mixed, can fully take the place of farm-yard manure," and that in New Hampshire they "can and do give greater increase of crop than commercial fertilizers" (See Bulletin No. 10 of the station, or Experiment Station Record, Vol. II, p. 412).

Directions are given as to "how to get chemical fertilizers," and the formulas for home-mixed fertilizers for corn and potatoes are reprinted from Bulletins Nos. 6 and 10 of the station.

New York State Station, Bulletin No. 27 (New Series), February, 1891 (pp. 20).

GENERAL PRINCIPLES UNDERLYING THE USE OF FERTILIZERS, P. COLLIER, PH. D. (pp. 416–430).—This is a conclusion of the popular treatise on the principles underlying the use of fertilizers, begun in Bulletin No. 26 (new series) of the station (See Experiment Station Record, Vol. II, p. 659), and treats of certain constituents of plants, the most important elements of plant food in relation to fertilizers, the constituents of soils, and the relations of plants and soils.

FERTILIZER ANALYSES, P. COLLIER, PH. D. (pp. 431–435).—The analyses are given of 20 samples of commercial fertilizers collected in the State in the fall of 1890.

New York State Station, Bulletin No. 28 (New Series), April, 1891 (pp. 9).

PIG-FEEDING EXPERIMENTS WITH COARSE FOODS, P. COLLIER, PH. D. (pp. 436–445).—"At different times during the year 1890 and the following winter feeding trials have been made with various coarse foods that are commonly grown on the farms of this State, many of which are often recommended for swine."

Prickley comfrey.—Two pens of Cheshire pigs, each pen containing two sows and a barrow, were fed from June 27 to July 18 "all the prickley comfrey they would eat, and a little corn meal. The comfrey formed over 90 per cent of the total food consumed in both pens." The tabulated

results show "a steady loss in weight with each lot for the period during which prickley comfrey was fed."

Oat-and-pea forage and red clover.—The same pigs were fed from July 18 to August 8, one lot with oat-and-pea forage, and the other with fresh second-growth red clover, a small quantity of corn meal being added in each case. The clover formed 89.6 per cent of the total food of one lot, and the oat and-pea forage 89.3 per cent of that of the other. The composition of each of the coarse fodders, average consumption of food, and gain in live weight are tabulated. The lot receiving clover gained 0.09 pound per day for each 100 pounds of live weight, consuming 31.89 pound of dry matter per pound of gain; and the lot receiving oat-and-pea forage averaged 0.45 pound of gain daily per 100 pounds live weight, consuming 7.37 pounds of dry matter per pound of gain.

At the current prices oat-and-pea forage "would only be profitable with the forage at about $2 per ton. The pigs receiving clover made so small a gain that there would be a loss from the corn meal fed, even if the clover was considered as representing no value."

Clover with and without salt.—The same pigs were fed clover for 28 days longer, salt (¼ ounce per 100 pounds live weight daily) being added to the ration of one lot. Those receiving salt made a better gain than in the preceding experiment, or than the lot receiving no salt.

In another experiment with two pens of Duroc-Jerseys, each pen containing three sows and two barrows, averaging 33 pounds each, a ration was fed consisting of clover (about 86.5 per cent) and corn meal, one lot receiving in addition 0.28 ounce of salt per 100 pounds of live weight daily. The results, as tabulated, show that from August 25 to September 29 the lot receiving salt averaged 0.34 pound of gain per 100 pounds of live weight daily, and the lot without salt 0.08 pound; the former consumed 10.97 pounds and the latter 48 pounds of dry matter per pound of gain in weight. "As with the other lots, those having salt made the better gain, the contrast being somewhat greater than before. The meager increase without salt was at a loss, and the gain made by those pigs having salt, without considering the manure, was unprofitable, even with the clover rated at less than $1 per ton."

Sorghum.—The two lots of Duroc Jerseys were changed to sorghum September 29, this coarse fodder (forming 89 per cent of the food) and a mixed grain ration being fed until October 20. One lot received in addition 0.24 ounce of salt per 100 pounds of live weight daily. The tabulated data show that the lot receiving salt gained 1.12 pounds and the other lot 0.7 pound per 100 pounds of live weight daily, the former consuming 3.32 pounds and the latter 5.96 pounds of dry matter per pound of gain. "Much the better gain was made by the lot receiving salt, and it was a profitable one with sorghum rated at $2 per ton. The gain made by the other lot, although more rapid than any made

when clover constituted a large per cent of the ration, was an unprofitable one at the fall prices, even with sorghum rated at $1 per ton."

Mangel-wurzels.—From October 27 to November 24 the sorghum in the rations of the above two lots was replaced by mangels, one lot receiving, as before, salt in addition. The results indicating the composition of mangels and sorghum for comparison, are tabulated. "The pigs receiving salt at the rate of about 0.2 ounce per day per hundred pounds here gave the poorest results, and the increase in weight was barely profitable with mangels rated so low as $1 per ton. The lot without salt made a profitable gain with mangels estimated at $3 per ton. * * * The mangels were eaten without waste, but no other coarse food was. The water-free food required per pound gain in weight was less than is usually obtained from any food excepting milk." After an intervening period, in which grain rations were fed, both the Cheshires and the Duroc-Jerseys were fed a ration of mangels and linseed meal, the mangels forming 95.7 per cent of the ration of the Cheshire and 97.5 per cent of that of the Duroc-Jerseys. As before, one lot of each breed was given a small quantity of salt in addition. The results of the trial are given in two tables. "At the prices of pork holding at the time of this feeding the gain made by the [Duroc-Jerseys] was profitable with linseed meal rated at $30 per ton and mangels at $2 per ton, without considering the manure. The gain made by [the Cheshires] was not profitable at these figures unless by taking into account the value of the manure."

New York Cornell Station, Bulletin No. 26, March, 1891 (pp. 26).

NOTES ON EGG-PLANTS, L. H. BAILEY, M. S., AND W. M. MUNSON, B. S. (pp. 3–20, illustrated).—In this article are given the results of several years' experience with egg-plants, including experiments in cultivation, with varieties, and in crossing.

Culture.—In the North "the plants should be started under glass from the middle of March to the middle of April in a warm house. * * * We sow in 'flats' or boxes, and when the first true leaves are about a half inch in diameter—which is about a month after the seed is sown—the plants are pricked off into 2-inch pots. As soon as the pots are filled with roots the plants are shifted into 4-inch pots. * * * The plants are transferred from the 4-inch pots to the garden from the first to the middle of June. The early sorts, as Early Dwarf Purple, are not so seriously injured by a check in growth as the large and late sorts, and they can therefore be handled with less care. These sorts can be started two weeks later than the others and receive but one transplanting."

Experiments indicated that "there is little or no gain in productiveness in the small early sorts from very early sowing, while the large sorts profit by it." Transplanting is apt to unfavorably affect the fruit-

fulness of the plant. Experiments are in progress to get light on the particular relations of transplanting to fruitfulness. "It is rare that all the plants in a large plantation of the common or late varieties mature fruit, and such kinds as Black Pekin, New York, and Giant Round Purple rarely mature more than two large fruits to the plant in this latitude, and often only one. The Early Dwarf Purple, Early Long Purple, and other early and medium varieties mature from four to eight fruits without difficulty." The value of continuous and careful selection with a view to securing uniformity in the setting of plants and the maturing of fruit is enforced by the experience of the station. "Breeding plants of uniform productiveness is the most important field in egg-plant experimentation at present."

Varieties.—Illustrated descriptive notes on fifteen American, French, and Japanese varieties.

The varieties of egg-plants, though not numerous, are exceedingly various. They represent wide differences in almost every particular, as habit, pubescence, spininess, color of plant and fruit, size and shape and season of fruit. The very large varieties, as New York Improved and Black Pekin, are most popular in the markets, but some of the earlier and smaller kinds are better. The white varieties find little demand in the markets, and there is an impression that they are unwholesome, but they possess no other fault than a hardness of flesh and rind in the case of the small varieties. The White Chinese is as good as any of the purple sorts for table use.

Experience in crossing.—In 1889 numerous crosses were made in three series, viz., (*a*) Round White with Black Pekin, (*b*) Giant Round Purple with White Chinese, and (*c*) Long White with Black Pekin. The seeds from these crosses were sown in 1890 and the results are stated in this article. The difference in productiveness of the different series was very marked, the percentages of barren plants being as follows: Series A, 22; B, 65; C, 80. In every case of artificial pollination fewer seeds were obtained than from those plants left to mature. The reason for this is not clear, and investigations will be made with reference to the laws controlling the influence of pollen. A few tests have indicated that the egg-plant may produce fruit without pollination. "Numerous crosses and selections have been made in these series and elsewhere for future investigations."

Summary.—

(1) Egg-plants are adapted to cultivation in the North. The requisites of success in growing them are these: early starting; warm quarters; vigorous plants; rather late transplanting to the field; warm, rich, and rather moist soil; constant attention to potato beetles; frequent cultivation.

(2) The best varieties for private use are Early Dwarf Purple, Early Long Purple, White Chinese, with perhaps Black Pekin for late.

(3) The best market varieties are New York Improved and Black Pekin, with perhaps Early Long Purple for the first demands.

(4) In crossing different races of egg-plants, the purple-fruited types appear to be stronger in their power to transmit color to offspring than do the white-fruited types; and this appears to hold whether the purple type is used as the staminate or the pistillate parent.

(5) The white-fruited types appear stronger in the power to transmit form and productiveness.

(6) Fewer seeds are produced by flowers artificially pollinated than by those left to mature, even though an excess of pollen is used.

(7) It is probable that the egg-plant may be included among those plants which are capable of producing fruit without the aid of pollen.

BOTANY OF THE EGG-PLANT, L. H. BAILEY, M. S. (pp. 21–26, illustrated).—An account of the history of the egg-plant, with brief descriptions of the varieties. The cultivated species *Solanum melongena*, Linn., is divided into three varieties:

(1) Var. *esculentum*, Nees (Trans. Linn. Soc. XVII, 50, 49). (*S. esculentum* and *S. ovigerum*, Dunal.) Plant stout and erect, mostly tall; leaves and branches more or less densely scurfy; leaves mostly conspicuously angled or lobed, thick; flowers large and thick on stout peduncles; fruit various, globular or oblong, white or purple. * * * There is a very low and dwarf form with rounded and barely undulate leaves and much smaller flowers, but I am unable to find good botanical characters to separate it from the larger forms.

(2) Var. *serpentinum*. (*S. serpentinum*, Desf. Dunal, DC. Prodr. XIII. 2, 358.) This differs from the var. *esculentum* chiefly in the greatly elongated fruit, which is curled at the end, and perhaps it is not worth separation. It is the most singular egg-plant which we have grown.

(3) Var. *depressum*. Plant low, weak and diffuse, dark colored, nearly smooth, always spineless; leaves small and comparatively thin, more entire, often scarcely angled; flowers small, mostly long-peduncled; fruit purple, pyriform. I am not aware that botanists have ever noticed this type of egg-plant, although I am inclined to think that Rumphius meant to portray it in his figure 85 (Rumph. Amb. 5, t. 85). Dunal (DC. Prodr., l. c., 355) refers to Rumphius' description but thinks his figure incorrect. I think that this is a distinct species.

Solanum integrifolium, Poir. This species is sold as the Chinese Scarlet and Ornamental egg-plant, and it is probably the one which has been lately distributed as a great novelty under the name of Tomato egg-plant. It goes under the name of *Solanum coccineum*. It is undoubtedly the *Solanum texanum* of Dunal (l. c., 359), which, as Asa Gray (Synop. Fl. II, 227) determines, is probably not Texan nor even American. It is undoubtedly identical with Poiret's *S. integrifolium*, as, in fact, Dunal himself suggested. I once thought that the common name, Chinese egg-plant, might throw some light upon the nativity of this species, but it appears to have been first known as the Ethiopian apple (*Mala æthiopica*, Dodoens, 1616). Its nativity appears to be wholly unknown. Dunal says that *S. integrifolium* is a native of Mauritius, but Baker, in his Flora of Mauritius, does not mention it. It is probably African. At any rate it appears to be proper to recall the name under which it was long known in early times, and I have therefore called it the Ethiopian solanum or egg-plant. This species was figured by Dalechamp (Hist. Gen., 633) in 1587 as *Capsicum rotundum*. Morison (Plant. Ox., sect. 13, t. 2) figured it in 1715 and Jacquin (Hort. Vind., t. 12) gives an excellent colored plate of it.

The Ethiopian egg-plant is a coarse plant 3 feet high with large-lobed leaves and the stems, petioles, and midribs armed with strong and very sharp spines a half inch long. The small white flowers are usually borne in clusters of two to six. The fruit is small, rarely much exceeding 2 inches in diameter, bright scarlet or yellow, and conspicuously lobed after the manner of the old Early Red tomato. We have grown two types of this plant, one of strong upright growth with purple stems, petioles, and midribs; the other of spreading habit and lighter color. The species is only curious and ornamental, the fruits not being eaten.

North Dakota Station, First Annual Report, 1890 (pp. 17).

REPORT OF DIRECTOR, H. E. STOCKBRIDGE, PH. D.—The station was established under an act of the legislature of the State, approved March 8, 1890. A temporary organization was effected May 15, 1890, when S. T. Satterthwaite was appointed director, with James Holes and Jacob Lowell as assistants. The present director and the permanent staff of the station took charge of the work October 15, 1890. Some field work on grasses, grain, and sugar-beets has been performed on land leased for the purpose. Collections of native grasses and weeds, and studies on the diseases of grain have been begun. Investigations in dairying are in progress. Analyses of sugar-beets, soils, waters, etc., are being made, as well as investigations of blackleg and tuberculosis. The station has conveniently arranged and well-equipped offices and laboratories, but is as yet without land for experimental purposes.

North Dakota Station, Bulletin No. 1, January, 1891 (pp. 28).

GRAIN SMUTS, H. L. BOLLEY, M. S. (illustrated).—Accounts of loose smut and stinking smut, with directions for treatment with sulphate of copper and hot water.

North Dakota Station, Bulletin No. 2, April, 1891 (pp. 18).

SMALL FRUITS, C. B. WALDRON, B. S.—General statements are made regarding the conditions under which fruit must be grown in the Northwest. The methods of cultivation and the varieties recommended by J. S. Harris of Minnesota, a fruit grower of long experience, in a course of lectures at the North Dakota Agricultural College, are given in this article. The fruits mentioned are strawberries, raspberries, blackberries, currants, gooseberries, and plums.

Oregon Station, Bulletin No. 11, May, 1891 (pp. 23).

NOTES ON GRASSES AND POTATOES, H. T. FRENCH, M. S. (illustrated).

Grasses (pp. 3–9).—Tabulated data are given for the yield of hay and loss of weight in curing for 17 varieties grown at the station. There are also brief descriptive notes on a number of these varieties. Tall fescue (*Festuca elatior*), Meadow fescue (*Festuca pratensis*), orchard grass (*Dactylis glomerata*), tall oat grass (*Arrhenatherum avenaceum*), perennial rye-grass (*Lolium perenne*), creeping bent-grass (*Agrostis stolonifera*), and Texas blue-grass (*Poa arachnifera*) have given the best results thus far.

Potatoes (pp. 10–23).—Tabulated data are given for 39 varieties, and for small experiments with fertilizers and with different amounts of seed. There is also a list of 375 varieties. Garfield, Alexander No. 1, Early Sunrise, and Rural New Yorker No. 2 are especially commended and are illustrated in cuts.

Pennsylvania Station, Bulletin No. 15, April, 1891 (pp. 13).

INFLUENCE OF VARIETY AND OF RATE OF SEEDING ON THE YIELD OF SILAGE CORN, H. P. ARMSBY, PH. D.—This is a report of an experiment to determine the influence of variety and rate of seeding on the total yield, composition, and digestibility of green fodder. The general plan was, using the same fertilizers (barn-yard manure and dissolved South Carolina rock), to plant a variety of dent corn (unnamed) and a larger variety (Breck's Boston Market Ensilage) each on four (about one twentieth acre) plats, in rows 3½ feet apart, and at the rate of one kernel every 3½ inches and of one every 14 inches in the row; and to determine the rate of digestibility of the corn for each variety and each rate of seeding by feeding trials with sheep.

The method of planting, rate of seeding, manuring, cultivation, and harvesting are described and the yield, composition, and rate of digestibility of the green crop are tabulated for each variety and each rate of seeding. The results, as calculated by the author, show that in this single experiment there was a larger yield of dry matter and that this had a somewhat higher rate of digestibility where the seeding was thicker and where the larger variety of corn was used. "The thick-seeded corn reached nearly the same stage of maturity as the thin-seeded."

As mentioned in the bulletin, however, there were several things other than variety and rate of seeding which may have considerably influenced the results and which make them merely suggestive. It is hoped to continue the experiments the coming season.

South Dakota Station, Bulletin No. 23, April, 1891 (pp. 31).

FOREST-TREES, FRUITS, AND VEGETABLES, C. A. KEFFER, M. H. (pp. 123–149).—The importance of tree planting is urged, methods of grove, street, and lawn planting are discussed, and the advantages of certain varieties of trees for groves, streets, or lawns are set forth. For grove planting the cotton-wood (*Populus monilifera*), white willow, box-elder (*Negundo aceroides*), and soft (silver) maple (*Acer dasycarpum*) are recommended as rapid-growing varieties, and green ash (*Fraxinus viridis*), white elm (*Ulmus americana*), black wild cherry (*Prunus serotina*), hackberry (*Celtis occidentalis*), black walnut (*Juglans nigra*), butternut (*Juglans cinerea*), burr oak (*Quercus macrocarpa*), and black oak (*Quercus nigra*) as slow-growing varieties. Some varieties of Russian poplars and willows are promising, and among evergreens the Scotch pine, red cedar, and white spruce may be grown throughout the State.

Suggestions are made regarding the varieties of fruits and vegetables most likely to succeed in South Dakota. The experiments with orchard fruits at the station have not been in progress long enough to give results of value.

Strawberries.—Crescent, Windsor, Manchester, Glendale, and Mount Vernon have given the best results at the station.

Gooseberries.—"Houghton and Mountain Seedling gave heavy crops the past season, and both sorts are hardy here."

Currants.—Victoria, Red Dutch, and White Dutch are recommended.

Texas Station, Third Annual Report, 1890 (pp. 13).

This contains the reports of the director and agriculturist, chemist, veterinarian, horticulturist, meteorologist, and treasurer, which include outlines of the work of the station.

In addition to the work at the station, experiments are being carried on at Harlem, Fort Bend County, in sugar investigation; at Gatesville, Coryell County, with grasses; at McGregor, McLennan County, with wheat and other crops; and at Rusk, Cherokee County, Huntsville, Walker County, and Prairie View, Waller County, in horticulture.

The averages of the meteorological observations at the station for 1889 and 1890 are as follows:

	Height of barometer in inches.	Temperature, Fah.			Rain-fall, per month, inches.	Prevailing wind.
		Mean.	Maximum.	Minimum.		
Average for 1889	29 694	66 04	89 30	46.79	4.215	S.
Average for 1890	29.714	66.97	91.37	43.50	3.370	S.

Texas Station, Bulletin No. 13, December, 1890 (pp. 12).

SORGHUM, TEOSINTE, ETC., H. H. HARRINGTON, M. S., D. ADRIANCE, M. S., AND P. S. TILSON, B. S. A. (pp. 29–40).—*Sorghum* (pp. 29–38).—This is a study of the sorghum plant, the object of which was "(1) to discover by analysis any differences that might exist in the different varieties of sorghum; (2) to discover any difference in the composition of sorghum between the time of 'dough state' and the time of ripening; (3) to find its value as a feeding stuff and as silage; (4) to estimate the amount of plant food removed from the soil by one crop."

Analyses are given of a large number of varieties of sorghum at the same stage of growth, the analyses in nearly every case representing the cane at an earlier and a later stage of growth. The noticeable features accompanying the ripening of the cane were "(1) the increase of crude fat; (2) the decrease of crude fiber (woody material); (3) the increase of crude protein or nitrogenous substances; and (4) the increase of carbohydrates (starch, sugar, etc.)."

Between the non-saccharine and the saccharine sorghums there is a great difference. In the former there is notably a larger increase of dry matter that gives it an apparent but fictitious value over the saccharine sorghums. The mineral matter or ash is somewhat larger in the non-saccharine, and the carbohydrates or nitrogen-free extract is increased, chiefly in consequence of the increase of dry matter. The crude

fiber is very much increased, and it is this fact that detracts most from its value. At the last cutting nearly all the non-saccharine varieties were "pithy" and almost devoid of taste.

If we take the individual varieties, either among the saccharine or the nonsaccharine, there is hardly sufficient uniform difference to warrant the statement that one variety is better than another. While there would be a difference in the sugar content, this difference would be so small, or be partially neutralized by a change somewhere else, that no perceptible variation would appear in a practical feeding test.

Silage.—To compare the value of corn silage and sorghum silage one pit was filled with fodder corn, another with mixed sorghum, and a third was divided into four compartments, filled respectively with orange cane, dhoura corn, yellow field corn, and Kaffir corn. Three samples of silage from each pit or compartment were analyzed separately, and the results, together with the averages, are tabulated. These indicate "slight difference in favor of the field corn, but not so much difference as we anticipated. While the Kaffir corn compares very favorably with the field corn, except for its larger percentage of crude fiber, it is quite the equal of the field corn. If we take the field corn alone it does not differ sufficiently from the analyses of that reported from other stations to create noticeable comment. The difference still exists, apparently in favor of Southern-grown corn, but is not so marked here as in analytical results before obtained and referred to."

Analyses of stalk and head of sorghum.—Separate analyses are given of the stalk and the head or seed, with reference both to food and fertilizing constituents, and from the latter an estimate is made of the amounts of fertilizing ingredients removed from the soil by a crop of 20,000 pounds of green sorghum per acre. These figures are compared with the amounts of nitrogen, phosphoric acid, and potash removed by a crop of 20 bushels of wheat and its straw per acre, and of 30 bushels of corn, with cobs and husks, but exclusive of stalks.

Amounts of plant food removed by crops of sorghum, wheat, and corn from one acre.

	Sorghum.	Wheat.	Corn.
	Pounds.	*Pounds.*	*Pounds.*
Phosphoric acid	38.5	16.77	11.91
Potash	94	22.4	13.3
Nitrogen	39	28.5	31

Digestibility of green sorghum.—To determine the digestibility of sorghum in the "dough state," two milch cows were fed exclusively on green sorghum. The analyses of the moist and water-free silage, and data relative to the calculation of the digestibility are tabulated.

Co-efficients of digestibility.

	Dry matter.	Crude ash.	Crude fat.	Crude protein.	Crude cellulose.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Cow No. 1	73.3	43.8	81.6	55.7	75	78.2
Cow No. 2	73.1	39.5	81.3	51.1	74	78.7
Average	73.2	41.6	81.4	53.4	74.5	78.4

Conclusions.—The experiments with sorghum lead the author to the following conclusions:

(1) It is better, so far as nutrition is concerned, to let it nearly mature before cutting, but if intended for hay it should be sown thicker and cut earlier.

(2) The saccharine varieties are to be preferred to the non-saccharine, but between the saccharine there seems to be but little difference in nutritive ratio.

(3) It is an exhaustive crop, removing more mineral matter from the soil than is removed either by corn or wheat.

(4) It is a good milk producer when fed in the green state with other dry feed. Its digestibility compares favorbly with that of corn except for the nitrogenous matter.

Teosinte (p. 38).—Analyses with reference to food ingredients are given of samples of this plant collected every ten days, from August 1 to October 20, and again November 10; and for comparison analyses of sweet, yellow, yellow dhoura, and Mosby corn grown the same season. It is believed that "about the last of September in this climate would be the best time for harvesting the crop."

Miscellaneous analyses (pp. 39, 40).—Tests of meal from spoiled cotton-seed revealed no ptomaines, "but in many instances we believe these to be present, and it is quite probable that the bad effects following the use of meal are sometimes due to their poisonous influence." Analyses are tabulated for cotton-seed hulls, muck, greensand marls, brick, iron ore, and water.

Vermont Station, Bulletin No. 23, March, 1891 (pp. 15).

ANALYSES OF FERTILIZERS LICENSED FOR SALE IN THE STATE IN 1891, J. L. HILLS, B. S.—The bulletin contains the trade values of fertilizing ingredients, remarks on the valuation of fertilizers, analyses of 33 samples of commercial fertilizers collected within the State in 1890, and a comparison of the average composition and value of fertilizers licensed in 1890 and 1891. "A comparison of the average composition of the two years shows that there is no appreciable change in the character of the fertilizers sold in the State during the past two years."

West Virginia Station, Bulletin No. 11, September, 1890 (pp. 6).

METEOROLOGICAL AND CROP REPORTS, J. A. MYERS, PH. D. (pp. 262–267).—Reports of meteorological observations made at the station and of correspondents on meteorology, and the condition of live stock and crops, for September, 1890.

West Virginia Station, Bulletin No. 12, December, 1890 (pp. 7).

THE CANADA THISTLE, C. F. MILLSPAUGH, M. D. (pp. 268–274, illustrated).—An illustrated account of the Canada thistle (*Cnicus arvensis*), with suggestions as to means for its repression. The author states that the true Canada thistle has not yet seriously invaded the State, but that other weeds are often mistaken for it, among which are the teasle (*Dipsacus sylvestris*), blue weed (*Echium vulgare*), and Virginia thistle (*Cnicus virginianus*). A list of questions on weeds is also given, addressed to farmers with a view to collecting material for a bulletin on the weeds of the State.

ABSTRACTS OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY.

INSECT LIFE, VOL. III, NOS. 7 AND 8, APRIL, 1891 (pp. 305–357, illustrated).—The principal articles in this double number are on the Xanthium trypeta (*Trypeta æqualis*, Lw.), by C. L. Marlatt; variations in the Braconid genus *Lysiphlebus*, by D. W. Coquillett; birth of a beautiful exotic lepidopterous insect (*Castnia cronis*, var. *corningii*) in New York, by H. Edwards; the strawberry-leaf flea beetle (*Haltica ignita*) in Indiana, by F. M. Webster; another parasitic rove beetle (*Mascochara valida*, Lec.), by D. W. Coquillett; phosphorescent myriopods, by L. Bruner; the preparatory stages of *Eustrotia caduca*, by D. S. Kellicott; a list of *Sphingidæ* and *Bombycidæ* taken by electric lamps at Poughkeepsie, New York, by H. G. Dyar; steps toward a revision of Chambers's Index, with notes and descriptions of new species (*Lithocolletis betulivora* and *L. grindeliella*), continued, by Lord Walsingham.

BULLETIN NO. 24.

THE BOLL-WORM OF COTTON, F. W. MALLY (pp. 50, illustrated).—This is a preliminary report on the special investigation of the cotton boll-worm (*Heliothis armigera*, Hübn.) now being carried on under the direction of the entomologist of this Department.

The boll-worm was treated at some length in the Fourth Report of the U. S. Entomological Commission, and the chief object of the present investigation is to conduct further experiments with remedies, as well as to verify the value of those already employed. A thorough series of experiments has been planned with the diseases of *Heliothis* and allied insects, in the hope of being able to practically utilize them.

The following subjects are treated in the bulletin: Amount of injury caused by the boll-worm, food plants other than cotton, character and transformations of the insect, number of broods and hibernation, natural enemies, insect ravages easily mistaken for those of the boll-worm, remedies (topping of cotton, fall plowing, corn as a protection to cotton, lights for attracting the moths, poisoned sweets, pyrethrum and other vegetable insecticides), meteorological considerations, and insect diseases.

The results of the investigations thus far made are summed up by Professor Riley in an introduction to the bulletin, as follows:

It transpires that the ravages of the boll-worm have been overestimated, and that while from 20 to 30 per cent of the bolls are damaged in an average season in Mississippi, only about one third of this damage is done by this insect. Several other species which do work somewhat similar to that of the boll-worm are treated in this report. Some new food plants have been found, and a careful study has been made of the habits and life history, which are here treated with more care and detail than has heretofore been given to the subject. Two new parasites have been discovered, and observations have been made which show that the egg parasite (*Trichogramma pretiosa*, Riley) is an extremely important factor in the economy of this insect, as it is also in that of the cotton worm (*Aletia xylina*, Say), and the grass worm or fall army-worm (*Laphygma frugiperda*, Smith and Abbott). A careful count shows that 84 per cent of the eggs were destroyed by this useful parasite. All of the old remedies have once more been tested, and the use of corn as a trap crop is again shown to be one of the most satisfactory means of protecting the cotton crop. The old subjects of attracting the moths to lights and poisoned sweets have once more been carefully considered, and my former conclusions have been confirmed, that there is little to be hoped for from either of these methods. The pyrethrum experiments, from which I had much hope, have not proved very favorable, while experiments with a large series of other vegetable insecticides have given no practical results as yet.

The experiments with contagious diseases can not be reported upon in any detail at the present time, but a large number of cultures of several diseases of the imported cabbage-worm, the bronzy cut-worm, and of two other Noctuids have been secured and carried through the winter. What may prove to be a specific disease of the boll-worm has also been discovered, and cultures have been obtained. It appears from the few experiments made that the boll-worm is probably susceptible to the cabbage-worm disease, but positive statements can not be made until these experiments are confirmed by those of another season. A bacteriological laboratory has been established at Shreveport, Louisiana, and has been well fitted out with the necessary apparatus, so that work in this direction the coming season will not be hampered, except in the case of an unexpected paucity of boll-worms.

CIRCULAR NO. 1 (SECOND SERIES), MAY, 1891.

SOME OF THE MORE IMPORTANT INSECTICIDES (pp. 7).—Condensed information concerning kerosene emulsion, resin washes, London purple, Paris green, and white arsenic, including formulas for the preparation of these insecticides and directions for their application.

DIVISION OF CHEMISTRY.

BULLETIN NO. 29.

EXPERIMENTS WITH SORGHUM IN 1890, H. W. WILEY (pp. 125).—This contains a report on studies on the separation of sugar from sorghum juices, with special reference to the use of alcohol for this purpose (See Experiment Station Record, Vol. II, p. 469); the composition of the bodies precipitated by alcohol from sorghum sirups; results of the operations of the sorghum-sugar factories at Attica, Fort Scott, Topeka, Conway Springs, and Medicine Lodge, Kansas, in 1890, as shown by chemical control; general results of manufacturing work;

functions of experimental work; record of work in cane improvement by culture experiments at Medicine Lodge and Sterling, Kansas; studies of the different varieties of sorghum; work on crosses; culture experiments at College Park, Maryland; experiments at Starkville, Mississippi, by the Mississippi Station; and culture experiments at Fort Scott, Kansas.

The experiments carried on in Kansas for several years have indicated that sorghum may be developed in any particular direction by continuous selection of seed from cane having the qualities desired. At Sterling, for example, not only has the percentage of available sugar been increased by selection but an earlier maturity of the cane has been secured. In the development of varieties the soil and climate of particular localities must be taken into account. The experiments reported indicate that varieties which do well in Kansas give poor results in Mississippi, and that, therefore, experiments in selection must also be made in the latter State in order to secure varieties adapted to the peculiar conditions prevailing there.

BULLETIN No. 30.

EXPERIMENTS WITH SUGAR-BEETS IN 1890, H. W. WILEY (pp. 93).—This contains brief statements regarding the purchase and distribution of seeds, experiments at factories, and financial returns to beet growers; analytical data relating to beets grown in twenty-five States chiefly in Nebraska and Minnesota) from seed furnished by this Department; accounts of experiments with sugar-beets in Wisconsin and Kansas; analyses of beets made at the Minnesota Station; brief articles on the effect of soil on beet production, culture of the Klein Wanzleben original, and the systematic study of the different varieties of sugar-beets in Saxony (averages of Professor Maercker's analyses in 1888); some general conclusions regarding the sugar-beet industry in the United States; and, in an appendix, notes on sugar-beet culture in France and Germany, by W. Maxwell.

The results of the analyses at Grand Island and other places show that beets of high sugar content and great purity can be grown in many parts of the United States. The average size of the beets, however, in many places is too small to assume that their culture would prove profitable. It would be far better for all interests to grow beets averaging from 600 to 700 grams in weight, even if the percentage of sugar should drop one or two points. * * * The Department has organized an experiment station for the culture of the sugar-beet at Schuyler, Nebraska, and it is confidently expected that rich beets, with high tonnage, can be produced. * * * When we consider the varying qualities of beets which have been grown from the same seed, we are at once struck with the immense importance of the factors of soil, climate, and cultivation in the production of the sugar-beet. In view of the fact that the seed of the Klein Wanzleben variety of beet in the hands of different farmers will show a variation of from 6 to nearly 20 per cent of sugar, it must be confessed that we have in soil and climatic conditions, and in methods of cultivation, a more potent means of influencing the sugar content of the beet than is found in the germ of the seed itself.

It can only be expected that a sugar-beet seed which is high bred will be able to reproduce its kind when it has become fully acclimated and has received in its new condition the same scientific treatment and selection which it had in its original home. The great hope, therefore, of uniform production in the United States of sugar-beets high in sugar-producing power must be found in the establishment of culture stations where different varieties of beets can become fully acclimated, and where they can receive the same careful scientific culture and selection which have brought them up to their present state of excellence in Europe.

DIVISION OF STATISTICS.

REPORT NO. 84 (NEW SERIES), MAY, 1891 (pp. 159-238).—This includes articles on the condition of winter wheat, rye, barley, and mowing and pasture lands; progress of cotton planting; spring plowing; changes in cultivated area; effect of May frosts; temperature and rain-fall; reports of State agents; better times for farmers; recent facts regarding ramie; agriculture in Brazil; European crop report for May; notes on foreign agriculture; and transportation rates for May.

DIVISION OF VEGETABLE PATHOLOGY.

JOURNAL OF MYCOLOGY, VOL. VI, NO. 4 (pp. 136-207, illustrated).—This number includes the following articles: Experiments in the treatment of plant diseases, Part II—treatment of pear-leaf blight and scab in the orchard, by B. T. Galloway and D. G. Fairchild; the peach rosette, by E. F. Smith; tuberculosis of the olive, by N. B. Pierce; recent investigations of smut fungi and smut diseases (concluded), by Dr. Oskar Brefeld; ripe rot of grapes and apples, by E. A. Southworth; anthracnose of cotton, by G. F. Atkinson; mycological notes. II, by G. Massee; index to North American mycological literature (continued), by D. G. Fairchild; indexes to Vol. VI of Journal of Mycology.

DIVISION OF POMOLOGY.

BULLETIN NO. 4.

RELATIVE MERIT OF VARIOUS STOCKS FOR THE ORANGE, H. E. VAN DEMAN (pp. 21).—This bulletin is based on replies to a circular of inquiry sent to orange growers in Florida and Louisiana, and contains a brief discussion of the relative merits of sweet, sour, rough lemon, pomelo, and other stocks for the orange; recommendations regarding the use of orange stocks in Florida, Louisiana, and California; a description of mal di Goma (foot rot, gum disease, sore shin, etc.), with suggestions as to treatment; and a discussion of the mutual influence of stock and scion.

For Florida the rough lemon stock is especially recommended on

high pine land, and the sour stock is more highly esteemed than the sweet stock on all kinds of land. In Louisiana the sour stock is preferred by about 90 per cent of the planters.

"From data sent by California orange growers who have tried the sweet and sour orange stocks side by side on a large scale, it is safe to conclude (1) that the sour-stock trees make a more thrifty growth; (2) that they are more free from disease and are entirely resistant to mal di Goma (foot rot or gum disease); (3) that they are less liable to be injured by cold while young; (4) that the quality of the fruit is not impaired."

ABSTRACTS OF REPORTS OF EUROPEAN INVESTIGATIONS.

Recent investigations concerning the organisms of nitrification, S. Winogradsky (*An. de l'Inst. Pasteur*, 4 (1890); *pp.* 213, 257, 760, *and* 5 (1891) *p.* 92).—The interesting question as to the cause of the nitrification of ammonium salts in soils has recently found a definite answer in the investigations of S. Winogradsky at Zurich. The nitrifying organisms so often searched for seem to have been found, successfully isolated and cultivated, and their characters, nitrifying action, and methods of culture carefully studied.

In connection with a report of his own work, the author reviews some of the more important investigations previously made on this subject. As is well known, Schlösing and Müntz* showed nitrification to be due to lower forms of life and to take place only in their presence. They were not able, however, to isolate and cultivate these organisms.

In 1886 Heraeus† claimed to have reached positive results. He secured pure cultures from soil and from old urine, which after a time gave a slight reaction for nitric acid, but the nitrates formed were too small to be estimated. The nitric acid in these cultures may have been absorbed by the cultures from the air; and as he did not succeed in isolating and proving any organism to be capable of nitrification, his experiments are considered inconclusive.

A. B. Frank‡ isolated several forms of bacteria from soil, but as none of them produced nitrification he was inclined to believe that nitrification was not due to the action of organisms.

Celli and Marino Zucco § isolated five forms of bacteria from a water rich in nitric acid and tested their nitrifying action. The cultures showed a reaction for nitric acid with diphenylamin after several days, but the control cultures which had not been inoculated also showed this reaction, though somewhat weaker. Adametz ‖ investigated two samples of soil, and after several weeks' time secured only traces of nitrates in his cultures.

In 1887 Frank ¶ attempted to explain the phenomena of nitrification

* Compt. rend. 84, 85, 86, 89.
† Zeitsch. f. Hygiene 71, 193.
‡ Ber. d. d. bot. Ges., 1886.
§ Rendiconti della R. Accademia dei Lincei, 1886.
‖ Inaugural Dissertation, Leipzig, 1886.
¶ Landw. Jahrb., 1887.

by the action of inorganic substances, particularly that of alkalies, but this theory was opposed by the experiments of Landolt, Plath, and Baumann,* which indicated that purely chemical agencies do not suffice to explain the nitrification in the soil. Frank † replied, maintaining his position and insisting upon the fact that he had isolated and cultivated several microbes "by the ordinary methods," but despite repeated efforts, had not succeeded in producing even traces of nitrification by the pure cultures.

In the following year Warington ‡ studied a large number of bacteria with reference to their ability to nitrify, but without result. As he secured the phenomena of nitrification when he used soil instead of pure cultures, he concluded that the organism causing it must in the course of time be found.

Negative results were likewise secured in the experiments of P. and G. Frankland, § with cultures of a number of soil organisms which were carefully isolated and studied. The reduction of nitrates was several times observed but in no case was ammonia oxidized. But when soil from which these same organisms had been obtained was used for inoculation, active nitrification was easily obtained.

Up to the time Winogradsky || took up the study of the subject all attempts to isolate from the soil organisms which it could be conclusively proved were capable of producing nitrification, had, therefore, been unsuccessful. Various investigations, including especially those of Schlösing and Müntz, pointed clearly to the existence of nitrifying organisms in the soil. Winogradsky's previous experience had been such as to confirm his belief in such organisms. He had discovered ferments which caused the oxidation of hydrogen sulphide and which he had designated as sulpho-bacteria,¶ and others which caused the oxidation of ferrous to ferric compounds and to which he gave the name ferro-bacteria.** He reasoned that it was extremely probable that organisms should exist in water and in the soil capable of availing themselves of the abundant energy which would come from the oxidation of the ammonium compounds therein contained. It seemed to him probable that the number of species or varieties would be small, at least in any given specimen of soil. It seemed to him that the way to secure and study the nitrifying organisms would be, (1) to find a medium and the conditions in which they would thrive, and by which the growth of denitrifying organisms would be discouraged; (2) to continue the culture by this method long enough to eliminate for the most part the other (non-nitrifying or denitrifying) organisms; (3) when the cultures of the oxidizing organisms should have been obtained

* Landw. Jahrb., 1887, and Landw. Versuchs-Stationen, 38, 1888.

† Ibid.

‡ Report of experiments made in the Rothamsted Laboratory. London, 1888.

§ Zeitsch. f. Hygiene, 6.

|| An. de l'Institut Pasteur, 1890.

¶ Bot. Zeitung, 1887.

** Ibid. 1888.

reasonably pure and their nitrification of ammonia active, to proceed to isolate the several organisms and study the characters and especially the nitrifying power of each with pure cultures. All previous attempts to isolate the organisms had been by means of gelatin cultures. He reasoned that as no organisms had been secured capable of producing nitrification in any considerable degree, that probably the organism causing this phenomenon, like many others, would not grow in gelatin. If this was the case other methods of culture must be adopted for its isolation. He began by working with two soils, one rich in organic matter, the other poor in organic matter but having large amounts of carbonates. He studied the cultures in media said to be favorable to the nitrification and unfavorable to reduction, and by continuing the cultivation in these media he was able in time to exterminate those forms to which the conditions of nitrification were unfavorable. When no further changes were noticed in the bacteria in the solutions he isolated the forms there present, and studied them separately with regard to their ability to nitrify. He found that the presence of organic matter in the culture media hindered nitrification, and he therefore used media composed entirely of inorganic salts and pure water. The medium finally settled upon was composed of 1,000 grams of water from Lake Zurich and 1 gram each of ammonium sulphate and potassium phosphate, to which was added 0.5–1 gram of basic magnesium carbonate per 100 c. c. of solution. When this culture medium was inoculated with material from a culture in which nitrification had taken place, the nitrification was so energetic that after 15 days every trace of ammonia had disappeared; while the same solution without inoculation showed only a slight nitric acid reaction after 2 weeks.

Cultures were continued and repeated in this medium. The number of species grew less and less and after three months cultures were obtained which could be regarded as containing only those species which were adapted to the conditions thus provided and might be expected to remain constant under these conditions. This species included the nitrifying organisms and several others.

The problem now was to isolate the nitrifying organisms. As the first step, gelatin cultures were made in the ordinary way and five species or organisms were found which formed colonies. Three of them were bacteria, one was a small oïdium, and the remaining one a peculiar organism, which probably belonged to the group of sprouting fungi, and is referred to beyond as a "fungus." Tests showed that neither of these species of organisms caused the nitrification of the ammonia salt in the liquid.

It thus appeared that in the liquid, which contained extremely little organic mattter and very small percentages of mineral salts including ammonium sulphate, the ammonium was rapidly nitrified, but that when portions of this culture liquid, in which nitrification was so active, were put upon gelatin only a limited number of organisms developed

colonies and that none of those which were thus grown in gelatin caused nitrification. The nitrifying ferment was still to be discovered.

In the cultures in the liquid referred to it was observed that a very thin film gradually formed on the surface of the culture, and a slight cloudiness of the solution was noted at times. The latter disappeared after a time, and was, as microscopic examination showed, caused by the presence of an oval, somewhat spindle-shaped organism' which moved about very rapidly. Nitrification was at the same time very active. It was thought that the film on the surface might contain the nitrifying organisms, as the acetic acid bacteria and other oxidizing ferments work at the surface where plenty of oxygen can be obtained; but tests with this gave negative results.

The plan of work was now somewhat changed: The attempt was made to cultivate the nitrifying organisms more abundantly. To this end a quantity of ammonium sulphate was added to the nitrified cultures, and the process of nitrification thus continued in the culture for some time. A change was noticed in the magnesium carbonate at the bottom of the solution, which gradually assumed a grayish color and a gelatinous consistency. By shaking the solution vigorously this mass was broken up into small flakes, which a microscopic examination showed to consist of transparent particles of the salt covered with a mass of oval bacteria, identical in form with those which had previously been noticed as the cause of the cloudiness. These bacteria seemed to be on the particles exclusively and not on the walls of the flask, and slowly enveloped the salt which was finally dissolved.

A culture medium was then prepared which was free from every trace of organic matter. On being inoculated nitrification took place in this energetically, and it was found to contain large numbers of the oval bacteria, as well as the fungous form previously noticed, but the other forms had all disappeared. The fungus remained constant, and all attempts to cultivate it out were unsuccessful.

The research was thus brought to the stage where it seemed probable that the oval bacteria might be the nitrifying agents. To test their nature and action satisfactorily the removal of the sprouting fungus was called for. To accomplish this, Winogradsky resorted to a very ingenious though simple device. The fungus would develop in gelatin; the bacteria would not. Small particles of the carbonate, more or less enveloped by the bacteria, were taken from the bottom of the culture flask by means of a capillary tube, and placed in a large flask of sterilized water; the contents of the flask were then well shaken and a gelatin plate inoculated with drops of the liquid, the particles of carbonate serving to indicate the places where the gelatin had been inoculated. In some of these the fungus developed. Inoculations of the culture liquid from the other spots failed to yield the fungus but developed the bacteria. By this method of "inverse gelatin culture" the bacteria were obtained pure. In culture liquid

inoculated with the bacteria ammonia was oxidized rapidly. The inference is that the bacteria are the nitrifying organisms of the soil.

Winogradsky describes the organism as of oval form, about 1.1–1.8 μ long and 0.9–1 μ wide, usually at rest, but capable of motion at times, and dividing perpendicularly to the longest axis. He places it in a genus by itself, which he calls *Nitromonas*. Whether only one single form of nitrifying bacteria exists or whether there are other forms, Winogradsky does not attempt to say at present. The soil about Zurich gave only this one form, and a sample of soil from a distant locality gave bacteria in every way resembling it. But he is inclined to believe there may be several species and chooses to refer to them not as a single ferment but as a physiological group whose special function is the oxidation of ammonia; and having designated those which cause the oxidation of sulphur and iron compounds as sulpho-bacteria and ferro-bacteria he applies to these the term nitro-bacteria.

By way of comparing the nitrifying activity of the nitromonas with that of the nitrifying ferments as they may actually occur in the soil, Winogradsky made a series of experiments to compare the amount of nitrification in his culture liquid with that observed by Schlösing in a soil to which, however, more oxygen had access than was the case with Winogradsky's liquid.

While in Schlösing's experiments by the use of 200 grams of earth, 3.4, 9, and 4.1 mg. of nitrogen, respectively, were nitrified, Winogradsky's pure cultures of bacteria nitrified 860 mg. of ammonium sulphate in 37 days and 930 mg. in 30 days, which in the period at which the nitrification was most energetic would furnish about 7.2 mg. of nitrogen per day.

Winogradsky further investigated the interesting and very remarkable fact previously cited, that the nitromonas, although it contains no chlorophyll, grows and is able to multiply in a solution entirely free from organic matter. To prove this fact beyond doubt he prepared a culture medium absolutely free from every trace of organic matter by using water distilled twice and tested, and salts which had been carefully purified by recrystallization. He thoroughly removed all organic matter from the glass dishes and apparatus to be used, and inoculated separate portions of the medium with the nitromonas. All of the cultures developed normally, and in the dark as well as in the light. To gain an idea of the extent of the assimilation of carbon the carbon in the organic matter which had been formed by the organism in its growth was determined by analysis. Four cultures contained respectively, 10.2, 7.1, 4.6, and 4.8 mg. of assimilated carbon; and in these cultures, respectively, 928, 604, and 83.5 mg. of nitric acid had been formed. This seemed to leave no doubt that nitromonas is able to assimilate the carbon of carbonic acid.

The oxidation of ammonium salts by nitromonas, according to Winogradsky, takes place only in the presence of atmospheric oxygen; the

oxygen of carbonic acid can not be used for this purpose, and he believes that no decomposition of the absorbed carbonic acid takes place. Exact determinations by Schlösing of the oxygen absorbed during the period of nitrification show the supply to be sufficient for the oxidation which takes place.

The synthesis of organic matter from inorganic compounds in the presence of chlorophyll is a most familiar fact. It has been assumed that this synthesis occurs in vegetable organisms only in the presence of chlorophyll with the aid of the sun's rays or equivalent source of energy, as, for instance, electric or other artificia llight. The possibility of life without organic matter was suggested by Heraeus, though his experiments did not prove it. It was advocated by Hueppe, who attributed it to nitrifying ferments which could cause the union of the elements of carbon dioxide and water to form carbohydrates, and could do this even in diffused sunlight. For this process he used the phrase "chlorophyll action without chlorophyll."

Winogradsky's experiments show that the nitromonas has the power of assimilating the carbon of carbonic acid and building up its own substance in entire absence of organic matter and in entire darkness. In other words, we have here the complete synthesis of organic matter by the action of living organisms without the aid of the energy of the sun's rays.

The question as to the oxidation of nitrogen to nitrous or to nitric acid by the nitrifying ferment has been studied by Winogradsky as by Schlösing and others. In brief it appears that in soils with sufficient aeration and temperature and other conditions favorable to oxidation, nitric acid is the main product, but with inadequate oxygen supply, low temperature and excess of alkali considerable nitrous acid is formed. Winogradsky found that in liquid cultures the quantity of ammoniacal nitrogen oxidized increased with the amount of oxygen (air) accessible, but the nitrous fermentation prevailed and but little nitric acid was formed.

The relation between the quantities of nitrogen oxidized and carbon assimilated was observed by Winogradsky in four liquid cultures, free from organic matter at the outset. From 33.3 to 36.6, or on the average 35.4 mg. of nitrogen were found in the forms of nitrous and nitric acids for each mg. of organic carbon, *i. e.* carbon of the nitro-bacteria developed while the oxidation took place. The fact that this relation was so nearly the same in the different trials although the conditions varied widely can hardly be without significance.

As regards the nature of the synthesis of organic matter by the nitro-bacteria, Winogradsky is inclined to the belief that some sort of an amide compound is formed in the culture at the expense of the carbonic acid absorbed (from the carbonate or the air) and the ammonia in the solution. Urea suggests itself in this connection, since this substance is formed both artificially and synthetically in the animal organism by the union of carbonic acid and ammonia. Certain bacteria are already

known to live upon urea, and nitromonas would then merely possess the advantage over these bacteria of being able to manufacture for itself the urea upon which it lived.

The chemical changes induced by the nitromonas differ materially from those which occur with chlorophyll. In the action of chlorophyll carbon dioxide is decomposed with the aid of the sun's energy, oxygen is liberated, and the carbon unites with hydrogen and oxygen to form carbohydrates indirectly. But, as indicated by Winogradsky's experiments and inferences, the nitro-bacteria instead of decomposing carbon dioxide and setting its oxygen free, effects its union with ammonia and the formation of amide-like compounds; they also make use of the oxygen of the air to oxidize the nitrogen to nitrous and nitric acids; and finally the energy required for their work is supplied from the oxidation which they bring about.

In the last article at hand Winogradsky discusses the methods of culture of the nitrobacteria, and especially a culture medium of which hydrated silica is an essential constituent, and in which mineral salts but no organic matter are used. This serves its purpose excellently and has the special advantage that few other organisms than the nitromonas grow in it.

The water-soluble phosphoric acid compounds in superphosphates, J. Stoklasa (*Landw. Versuchs-Stationen*, 38, *pp.* 401–410, continued from *Ibid., p.* 197; see Experiment Station Record, Vol. II, p. 611).

Action of dicalcic phosphate.—Working with pure material, an interesting occurrence was noticed in the formation of monocalcic phosphate by the action of a solution of free phosphoric acid on dicalcic phosphate. The phosphoric acid unites with the dicalcic phosphate until the solution is completely saturated, *i. e.* contains practically 1 gram of the salt to 200 grams of water, as stated in the previous paper. After saturation has been reached the dicalcic phosphate remains unacted upon by the free acid.

According to Reichart,* Boedecker,† and others, if dicalcic phosphate is boiled with water, monocalcic phosphate is formed. Erlenmayer‡ states that after 24 hours' boiling only a weak reaction was noticed with litmus paper. The author heated 2.5 grams of dicalcic phosphate with 500 c.c. water; at the end of 36 hours only a very weak reaction was noticed with litmus tincture. Analyses of the watery solution, 0.03–0.05 per cent of phosphoric acid which had been dissolved from the dicalcic salt.

To study the action of dicalcic upon monocalcic phosphate, the two were mixed in the proportions of 5, 2.5, and 1 gram, respectively of diphosphate to 5 grams of monophosphate in 2,000 c. c. water. After standing for months, with frequent shaking, the per centage of free

* Archiv. Pharm., 3, 2, p. 236.
† Annal. Pharm., 69, p. 206.
‡ Sitzungsberichte d. K. B. Akad. d. Wiss., 1872, p. 269.

phosphoric acid in the solution remained practically unchanged, indicating that the dicalcic phosphate had caused no decomposition of the monophosphate.

Action of tricalcic phosphate.—To study the action of tricalcic on monocalcic phosphate, 3.46 grams of the former and 2.52 grams of the latter were placed in each of eight 2 litre flasks, and the flasks were then filled to the mouth with water. The soluble phosphoric acid was determined in the solution in each flask after 2 hours, 1, 2, 5, 14, and 30 days, and 6 and 12 months, respectively. The results showed that the tricalcic phosphate acted but slowly on the soluble monocalcic phosphate. The percentage of soluble acid, which after 2 days' standing was 56.63, was reduced to 0.59 per cent after 8 months' standing. When 2.52 grams of monocalcic and 3.46 grams of tricalcic phosphate were dried in a platinum dish at 100° C. for 6 hours a loss equal to 2 per cent of the soluble phosphoric acid was noticed. According to these trials the decomposition is much more rapid with the phosphates in a dry state than in solution.

In a series of experiments 2.52 grams of monocalcic, 3.46 grams of tricalcic phosphate, and 0.98 gram of chemically pure orthophosphoric acid were mixed in a dry state, and in separate trials determinations made of the free and soluble phosphoric acid in the mixtures after a half hour, 2 hours, 5 days, and 10 days. In these trials, as indicated by the results, the free phosphoric acid and the tricalcic phosphate formed a dicalcic phosphate, the monocalcic phosphate remaining unchanged.

In similar experiments in which 0.098 gram of orthophosphoric acid, 0.756 gram of monocalcic, and 1.384 grams of tricalcic phosphate were used, it was found that the free phosphoric acid combined with 1 molecule of the tricalcic phosphate forming diphosphate, the remaining phosphate then forming dicalcic phosphate with the monophosphate.

These reactions may take place in the preparation and keeping of superphosphates, and the author believes they clear up certain points regarding the changes which superphosphates may undergo. They teach that the content of free phosphoric acid in superphosphates is a very important factor, as this acid plays a part second to none in the changes. If the superphosphate contains 15.4 per cent of water-soluble phosphoric acid including 8.2 per cent of P_2O_5 as free acid, it can contain 4 per cent of P_2O_5 as tricalcic phosphate and no reverted acid be formed; but the monophosphate, on the contrary, will increase until at last all the P_2O_5 of the triphosphate is changed to the soluble form.

When sulphuric acid weak or slightly in excess is used in the manufacture of superphosphates free P_2O_5 will be formed; when concentrated acid of 55–60° Bé. or no excess of acid of 50° Bé. is used, small amounts of free P_2O_5 are formed and reactions resulting in the formation of dicalcic phosphate may occur.

In all these processes the calcium sulphate may hinder the reactions by preventing the most advantageous conditions for the action of free phosphoric acid.

The above indicates that the tricalcic phosphate by its action on the monophosphate causes very interesting and significant changes.

Report of the agricultural-chemical experiment station at Halle for 1890, M. Maercker (*Zeitsch. d. landw. Central-Vereins d. Prov. Sachsen*, 1891, *pp.* 105–114).—This station, which is the station of the Central Agricultural Society of the Province of Saxony (Prussia), is located at the Agricultural Institute of the University of Halle. The director, Dr. Maercker, is also professor in the university. It has a branch station (*Filiale*) located at Magdeburg, under the direction of Dr. Waas.

The report for 1890 shows the personnel of the central station to consist of a director, assistant director, botanist, eight assistants, a secretary, an accountant, a gardener, and three helpers; and that of the branch station at Madgeburg to consist of a director, an assistant, and a helper, making 21 members of the working staff.

The work of the year included analyses, field and feeding experiments, experiments in sugar-beet culture, studies of soils, botanical examinations, tests of varieties, seed control, and distillery experiments. The analytical work of the main station was as follows: fertilizers, soils, etc., 3,223; feeding stuffs and sugar-beets, 1,814; botanical examinations (seed tests, etc.), 1,166; soils, with reference to phosphoric acid, 303; making in all 6,506 analyses. The branch station examined 1,901 samples of feeding stuffs and milk, and 397 samples of fertilizing materials.

In his review of the general quality of fertilizers and the extent of their use the past year, the author remarks upon the increased use of Thomas slag on fields used for sugar-beet culture, as well as on lighter soils and meadows, and states that 14 cases of adulteration of this ground slag with Redonda phosphate were noticed during the year.

In the botanical laboratory 547 samples of seeds and 298 samples of feeding stuffs were examined as to their purity. The author commends the work in these directions very highly, and regards a botanical laboratory, under the direction of a competent head, as of the utmost importance to every experiment station.

The majority of the experiments carried out by the station receive but brief mention in the short report given, the details and conclusions being reserved for future publication. The studies of soils with reference to phosphoric acid content are, however, reported at considerable length.

To study the relation of the phosphoric acid contained in different soils to plants growing in them, vegetation experiments were made with samples of typical soils containing in some cases like percentages and in others different percentages of phosphoric acid. The same kind of plants were grown in all cases, and at the end of the season determinations were made of the amount of phosphoric acid given up to the plants

by each soil. The results of the first year's trial showed that soils belonging to the same class and containing by analysis the same percentage of phosphoric acid, yielded widely varying amounts of phosphoric acid to the plants growing upon them. Thus of two samples of clayey soil, each of which contained by analysis 0.1 per cent of phosphoric acid and which were used for summer wheat, No. I gave up 0.341 gram of phosphoric acid to the crop, and No. II, 1.223 grams, the yield of grain and straw each being more than three times as large on soil II as on soil I. A large number of other soils also showed analogous differences. The conclusion was that in soils containing like amounts of phosphoric acid the amount of the acid which plants can utilize may be very different, so that the mere estimation of the phosphoric acid in a soil by analysis furnishes no indication of the supply which is available to plants. Tests of the two soils just mentioned with ammonium citrate, "Petermann's solution," by the method for determining so-called reverted phosphoric acid, revealed a decided difference between them with regard to the phosphoric acid dissolved; thus, soil I yielded 0.032 per cent and soil II 0.05 per cent of phosphoric acid. In additional tests very weak solutions of citric acid were used. The opinion is expressed that by the use of this re agent, in connection with vegetation tests, it will be possible to make an estimation of the phosphoric acid in a soil which is in a condition to be used by plants.

Along with these tests other studies were carried on with regard to the phosphoric acid in the harvested crop from different soils. The results of these show that the soil richest in citrate-soluble phosphoric acid produced plants containing the largest amounts of phosphoric acid, and that when nitrogenous fertilizers were applied to the soil, especially in sufficient quantities to noticeably increase the yield, there was a marked decrease in the phosphoric-acid content of the crop.

In an investigation as to the content and solubility of the phosphoric acid in the typical soils of the province, examinations were made of over 400 samples of different soils, the results of which showed the solubility to vary widely in different soils. In sandy soil, for instance, which of itself contained only a low percentage of phosphoric acid, the rate of solubility of the acid was found to be remarkably high; thus in some cases 95–100 per cent of the phosphoric acid present was dissolved by citrate of ammonia solution, while the rate of solubility for clayey soils is very much less.

Regarding the percentage of phosphoric acid contained in soils, the author gives the following general conclusions from his studies: Over 0.2 per cent of phosphoric acid is regarded as an unusually high content, occurring very rarely, 0.15–0.2 per cent as very high, 0.1–0.15 per cent as high, 0.1 per cent as the normal content of a good sugar-beet soil, 0.075 per cent as moderate, 0.05 per cent as low, and 0.025 per cent as very low.

On the composition of milk and milk products, P. Vieth (*Analyst, April, 1891, pp.* 61–67).—In a paper read before the Society of Public Analysts, Dr. Vieth presented a report of the work done in the laboratory under his charge during the year 1890. This work includes the analysis of 20,635 samples of milk, 1,188 of cream, 586 of skim-milk, 165 of butter and butter fat, besides numerous samples of buttermilk, whey, water, and sundry other articles.

Of the milk, 11,816 samples were taken on arrival from the country, and in order to keep a constant control over the men intrusted with its delivery to customers, 7,104 samples were taken before, during, and after delivery. The average of these analyses for the year is given as follows:

Average composition of milk and cream, 1890.

	On arrival.				Total solids		
	Specific gravity.	Total solids	Fat.	Solids not fat.	Before sent out.	During delivery.	After return.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent*
Milk	1.0322	12.84	3.74	9.10	12.76	12.88	12.92
Cream	....	....	....	....	48.3	48.4	....

"The lowest percentage of total solids and fats was found, as usual, in the second, and the highest in the fourth quarter of the year. * * * Skim-milk, resulting when cream was separated from milk by means of centrifugal cream separators, contained, as a rule, from 0.2 to 0.4 per cent of fat."

The volatile acids found in different butters in 1890 were, in "Wollny figures," as follows:

English butter, 25.3–30.0; average 27.6 c. c.
French butter, 25.6–30.8; average 28.7 c. c.
Kiel butter, 21.3–30.7; average 27.7 c. c.
Danish butter, 27.3–29.9; average 28.8 c. c.

The author mentions four cases in which the volatile acids of Kiel butter "derived from two large, well-known, and well-managed dairies in Holstein" were, respectively, 24.2, 22, 21.3. and 23.7, or below the usual limit. These same dairies furnished butter low in volatile acids in 1889. A study of this matter at the dairy experiment station at Kiel showed that "with the progress of the period of lactation the volatile acids decreased, reaching their lowest point in October, and that with the beginning of the calving season, in November, they at once increased and quickly rose above 25." Butter from an English farm, of which 32 samples were examined during the year, "fell below 25 from January to the middle of April and again from August to November. During the remaining part of the year the volatile acids varied from 25 to 26. The observed extremes were 22.1 and 26.2."

The volatile acids of butter fat which had been exposed to the action of air and light for 18 months and had become bleached, increased from 29.2 in the original to 30.4 in the bleached sample.

In experiments with regard to freezing milk, 2 gallons of milk contained in a tightly covered oblong vessel were placed in a refrigerated salt solution and kept at a temperature of 14° Fah. for 3 hours. Samples of ice from the top (cream) and bottom (skim-milk), and of the portion remaining liquid were analyzed with the following results:

Composition of frozen milk.

	Proportion.	Specific gravity.	Composition.				
			Water.	Fat.	Proteids.	Milk sugar.	Ash.
	Per cent.		*Per cent*	*Per cent.*	*Per cent*	*Per cent.*	*Per cent.*
Ice { Cream ...	8.8	1.0100	74.44	19.23	2.64	3.33	0.52
Ice { Skim-milk	64.7	1.0275	92.10	0.68	2.80	3.95	0.60
Liquid portion.	26 5	1.0325	80 54	5.17	5.38	7.77	1.18

These figures prove what has been shown on previous occasions, that frozen milk contains a much higher proportion of water than the original milk in which the ice was formed, and that the part remaining liquid is a concentrated milk. The ice is by no means a solid mass, but a conglomerate of crystalline plates. The fact that the latter when examined singly are found to be quite clear, proves that fat globules do not enter into the crystals. The component parts of the "solids not fat" seem to participate in the formation of the crystals in about the same relative proportion in which they are present in the milk. This was so at least in the case to which my remarks refer.

The behavior of milk when exposed to low temperatures is not without interest in itself, but apart from this it is also of some practical importance. People who are ignorant of what is actually taking place when milk freezes would naturally see no harm in melting milk ice and using the liquid obtained as milk. If a milk vender would proceed in this way he might easily get into trouble.

In the discussion which followed, the president of the society, R. Hehner, in referring to the cases of abnormally low content of volatile acids in butter cited by Dr. Vieth, said he had found that "when the price of butter rose the number of samples that yielded an abnormally low proportion of volatile acids at once went up," and he believed the practice of adulteration to be closely connected with the market price. In reply Dr. Vieth stated that his experience went the other way. He had analyzed a large number of samples of butter, chiefly from France, Holstein, Denmark, and Sweden, and had never found any definite connection between the prices of butter and the quantity of volatile acids. Referring to the ash in milk, he said that his observations on a large number of samples had shown the ash to be very nearly 8 per cent of the solids not fat.

The two following abstracts are from Bulletin No. 9 of the College of Agriculture, Tokio, Japan. Both of the articles from which they were taken were reported by Dr. O. Kellner:

Researches on the action of lime as a manure, with special regard to paddy fields, O. Kellner, H. Sakano, D. Sato, and S. Shinjo (pp. 1–25).—"In many

districts of Japan large quantities of lime, up to 300 kuwamme per tan [over 10,000 pounds per acre], have been annually applied to rice in the paddy fields, and continue to be resorted to, in spite of the conspicuous injury which is caused by this habit, and affects both soils and crops." With regard to the injury to the rice crop the author says, "the stems become, in consequence of too much lime, less flexible, and are thus liable to be broken down by the wind; wherefore the straw is rendered unfit for various braiding industries. The grain is even more affected than the straw. It acquires an inferior taste and luster and becomes lighter, the hulls grow thicker, the white spots in the grain become larger, and sensible losses are experienced during the hulling and cleaning because the grains being brittle, break during these operations."

The results of a complete analysis of samples of several varieties of brittle rice showed no difference between their composition and that of rice grown on unlimed soil, except a somewhat lower (about 1.5 per cent) content of protein. A comparison was then made in all samples of the content of protein and the pressure required to break the grains. The results of this comparison, although they show no exact proportionality between protein content and hardness, show that in these cases brittleness and a decreased protein content went hand in hand. The author concludes, therefore, that "the brittleness of the rice grown on overlimed soil is due to an indirect action of the lime, which favors the loss of nitrogenous nutrients from the soil, thus reducing the formation of albuminoids in the plant and their accumulation in the grain." But he adds that the brittleness of rice grains is not of necessity due exclusively to the excessive application of lime, "but may be found in all those cases in which the supply of nitrogen to the plant is insufficient."

To determine the action of lime on soils which are submerged by water for several months in the year and retain much moisture the remainder of the year, comparative trials were made as follows: Dry sifted paddy soil and dry land soil, each mixed with finely ground soja beans and water, with and without slacked lime, were placed in glass bottles closed with a rubber stopper carrying two glass tubes, through which air free from carbonic acid was conducted every two days, but which were otherwise kept closed air tight. Samples of each of these four mixtures were taken after two, four, and six weeks and analyzed. The amount of organic matter and combined water per 100 parts of mineral matter free from carbonic acid and the percentage of the original amount of organic matter destroyed were as follows:

Loss of organic matter.

	Organic matter per 100 parts of mineral matter.		Percentage of original dry matter destroyed.		
	Without lime.	With lime.	Without lime.	With lime.	Difference.
DRY LAND SOIL.					
Original mixture	36.90	34.64	....	....	....
After two weeks	36.28	32.02	1.69	7.55	5.86
After four weeks	35.95	30.96	2.57	10.61	8.04
After six weeks	35.71	29.94	3.24	13.58	10.34
PADDY SOIL.					
Original mixture	44.30	41.45	....	....	....
After two weeks	43.97	40.25	0.74	2.91	2.17
After four weeks	43.74	39.53	1.27	4.64	3.37
After six weeks	43.32	39.03	2.21	5.85	3.64

The author concludes that "(1) lime accelerates the decomposition of organic matters in both dry land and irrigated paddy soils. (2) This action is accomplished in dry land to a far larger extent and more rapidly than in irrigated soils."

The formation of nitric acid and ammonia from nitrogenous manures in dry land and paddy soils.—In a series of experiments made to study this subject and the action of lime in the process, nine glass jars 8 inches high by 6 inches in diameter were filled with sifted "dry-land soil," and nine with paddy soil. In the case of each kind of soil ammonium sulphate and ground fish manure were each added to three jars, a mixture of ground fish manure and lime to one jar, and two jars received no fertilizers. After filling the jars were sunk into the respective fields from which the soil had been taken and large glass plates were suspended over them to keep out dust and rain. The paddy soil was kept submerged about an inch in distilled water, and the dry-land soil was kept at the same degree of moisture as the surrounding field. The nitric acid was determined in jars receiving the same fertilizers after 30, 84, and 122 days. "The results plainly show (1) that in our dry-land soil the nitrogenous manures were speedily converted into nitric acid, while no such process took place in the irrigated paddy soil; in the latter, ammonia seems to be among the principal products of the decomposition of nitrogenous organic fertilizers; and (2) that the application of lime distinctly favors on the one hand the nitrification in the dry land, and on the other the formation of ammonia in the paddy soil."

Action of lime in preserving the assimilability of phosphoric acid.—To study the influence of lime on the action of soluble phosphatic fertilizers in the soil, bottles were filled with two kinds of soil, one from paddy fields and the other from the deeper subsoil of the dry lands. Lime was added to some of the bottles in amounts varying from 0.25 to 5 per cent of the soil at the outset. Each bottle received 20 c. c. of distilled water, and 2 weeks later 0.05 gram of phosphoric acid in the form of monopotassic phosphate. All were then placed under a bell glass

to prevent their drying. At the end of 1 month and again at the end of 2 months determinations were made of the amount of phosphoric acid in the soils dissolved by neutral ammonium citrate solution of 1.09 specific gravity at 30–40° C. in 30 minutes. The results of these determinations "prove plainly that in the top soil of the paddy field the presence of lime had an action decidedly beneficial to the preservation of the assimilability of the phosphoric acid applied in a soluble form, and that under the conditions of our experiment the maximum effect was obtained with from 1 to 2.5 per cent of lime in the air-dry soil." Where 1 per cent of lime was added there was nearly twice as much phosphoric acid soluble in ammonium citrate solution as where no lime was added. "It even appears that upon a longer action of the lime, after 2 months, some of the phosphate previously precipitated in a more insoluble form was rendered soluble in citrate solution by the presence of 0.25 gram of lime per bottle, *i. e.* 2.5 per cent. * * * Contrary to its beneficial action on the phosphates in the paddy soil, lime did not affect them to any appreciable extent in the irrigated subsoil from the dry field." As the two soils are of the same geological formation and differ only with respect to humus, which is abundant in the paddy soil, but almost entirely wanting in the yellow subsoil, the author believes the difference in the action of the lime in the two soils is traceable to the humus, which, together with the carbonic acid, "united with the lime at once and thus preserved it in a state in which it could still act on the soluble phosphates." But he does not believe that the lime will be without action on all soils poor in humus, and states that "in the majority of cases, as in sandy, clayey, and ordinary loam soils of paddy fields, a moderate dressing with lime previous to the application of superphosphates will certainly secure a good effect of the phosphoric acid on the crop, especially if the soils are ferruginous and would otherwise favor the formation of less assimilable basic phosphates of iron and alumina. For the same reasons in overlimed soils superphosphates are sure to have a good effect."

Experiments on the cultivation of Lespedeza bicolor, Turcz. (hagi), as a forage crop, O. Kellner, T. Yoshii, and M. Nagaoka (pp. 26–43).—The authors describe this plant as a "wild leguminous plant which is found in all parts of Japan, on cultivated land in the plains as well as in the mountains, up to a considerable height. Its stems grow 1 to 2 meters high, and if allowed to stand for several years, attain a diameter of 1 to 1.5 centimetres (0.4–0.6 inch) and become so woody and ramified that the plant has much the appearance of a shrub." The Japanese farmers "occasionally collect it from uncultivated lands, though they have never tried to raise it in the fields."

The yields are given of three separate cuttings each year since 1886, and the composition of each cutting. The authors find that "hagi hay has very nearly the same composition as hay of lucern. * * * Whenever an easily digestible fodder rich in protein is desired from

hagi, it must be cut at a far earlier period of growth than the common leguminous forage crops, otherwise the formation of fiber proceeds so far as to interfere with the digestibility. * * * In no case should the plants be allowed to stand till they are in full flower."

An experiment to determine the digestibility of hagi was made with two sheep, using the hay from the first cutting (May 24) of 1889. From November 5 to 18 each sheep received daily 1 kg. of the cut hay (pieces about 1 inch in length), 6 grams of common salt, and water *ad libitum.* After 6 days of preliminary feeding the uneaten residues of food, and the excreta were collected, weighed, and analyzed. The results were as follows:

Co-efficients of digestibility.

	Dry matter.	Crude protein.	Crude fat	Crude cellulose.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent*
Sheep No. 1	48 83	57.99	51.50	45.10	49.39
Sheep No. 2	49.48	60.03	54.56	48.55	45.03

"According to these results the digestibility of hagi hay is lower than that of most other leguminous forage crops."

Lespedeza bicolor, var. *sieboldi*, Maxim. (natsu hagi) which has also been cultivated at the college, is described as a smaller variety, yielding considerably less hay, but of a little better quality than that from the common hagi.

EXPERIMENT STATION NOTES.

The annual convention of the Association of American Agricultural Colleges and Experiment Stations will be held in Washington, August 12, 1891.

COLORADO STATION.—Nicolai Anderson has been appointed assistant chemist, vice H. L. Sabsovick, and Edward Bosher has been appointed superintendent of the San Luis Valley substation, vice H. H. Griffin, B. S.

CONNECTICUT STATE STATION.—Wm. C. Sturgis, Ph. D., has been appointed mycologist of the station, vice Roland Thaxter, Ph. D., who resigned to accept a professorship in Harvard University.

ILLINOIS STATION.—Frank D. Gardner, B. S., has been appointed assistant agriculturist.

INDIANA STATION.—C. S. Plumb, B. S., has been appointed director.

KENTUCKY STATION.—W. D. Nicholas has taken the place of R. A. Spurr as a member of the governing board of the station. It is expected that the station building which was partly destroyed by fire last winter, will again be ready for occupancy by the first of September.

MASSACHUSETTS COLLEGE AND STATION.—President H. H. Goodell received the degree of LL. D. from Amherst College at the recent commencement.

MINNESOTA STATION.—The regents of the University of Minnesota have appropriatd $15,000 for instruction and experiments in dairying, including both butter and cheese making. The director of the station is *ex officio*, one of five persons in charge of the farmers' institute work in the State. In this capacity he visits different sections of the State and explains the work of the station to farmers.

MISSOURI STATION.—The following is a synopsis of the plan of field experiments at the station in 1891: (1) Tests of varieties of wheat, rye, oats, barley, flax, grasses, sugar-beets, and tobacco—140 plats. (2) Corn, manuring; preparation of soil for planting; distance, thickness, and depth of planting; methods of cultivation; influence of the removal of tassels before fertilization and seed selection—131 plats. (3) Sugar-beets, tests with different varieties and with fertilizers, by some 75 farmers in different parts of the State under direction of the station- 300 plats. (4) Experiments with flax for seed and fiber—22 plats. (5) Test of tile drainage for upland clay loam—7 plats. (6) Effective subsoiling in connection with tile drainage—4 plats. (7) Potatoes, methods of cultivation—18 plats. (8) Rotation of crops—38 plats. (9) Timothy hay, influence of time of harvesting upon yield, feeding value, and subsequent crop—8 plats. Total number of plats, 668.

NORTH CAROLINA STATION.—In order to bring the work of the station more directly to the attention of the farmers of the State, the suballiances (numbering nearly 2,300) have been requested to form "experimental committees," the chairmen of which are to keep themselves in constant communication with the station. All the publications of the station, including press bulletins, will be sent to these committees, in order that the work of the station may be discussed in meetings of the alliances. At such meetings "question boxes" are also used, and the questions deposited by members are first discussed by the meeting and then referred to the station for further answer. Great interest in the plan is already shown among farmers.

PENNSYLVANIA STATION.—The "extractor separator," for making butter from fresh milk, is now being run regularly at the station on Mondays, Wednesdays, and Saturdays. Visitors are given every facility for investigating the operations of the machine.

RHODE ISLAND STATION.—J. D. Lowar, B. S., has been appointed assistant agriculturist, with general supervision of field work at the station and of co-operative field experiments with corn. B. L. Hartwell, B. S., has been appointed assistant chemist. In this State the inspection of fertilizers is made under the direction of the State board of agriculture. The chemical work connected with the inspection is now being done at the station instead of at Brown University, as heretofore.

UTAH STATION.—Feeding experiments with silage *vs.* dry fodder corn, recently completed, indicate that in the climate of Utah properly cured dry fodder will give better results than silage.

VIRGINIA STATION.—H. M. Magruder died suddenly June 1, at Washington, D. C.

WYOMING STATION.—The station has issued its first bulletin, describing its organization and plan of work. The station staff as now organized is as follows: Dice McLaren, M. S., director and agriculturist; B. C. Buffum, B. S., horticulturist; J. D. Conley, M. A., Ph. D., geologist and chemist; Aven Nelson, M. S., botanist; F. J. Niswander, B. S., entomologist; Edwin E. Slosson, B. S., chemist; Grace R. Hebard, B. S., M. A., secretary.

CALUMET PLANTATION, LOUISIANA.—Under the title Sorghum as a Sugar Plant for Lower Louisiana, by F. E. Coombs, there has recently been published a record and discussion of field and laboratory experiments with sorghum during 1889 and 1890, conducted under the direction of W. J. Thompson, at Calumet Plantation, Parish St. Mary, Louisiana.

CENSUS BULLETIN NO. 59, APRIL 29, 1891 (pp. 11).—A preliminary report on floriculture by J. H. Hale:

"While floriculture has been carried on as a business in this country for upward of one hundred years, it is only within the past twenty-five years that it has assumed large proportions. Out of a total of 4,659 establishments 2,795 were started between 1870 and 1890, and of these 1,797 between 1880 and 1890. There are 312 commercial floriculture establishments owned and managed by women. These 4,659 establishments had in use in the census year 38,823,247 square feet of glass, covering a space of more than 891 acres of ground. The establishments, including fixtures and heating apparatus, were valued at $38,355,722.43; tools and implements, $1,587,693.93; and gave employment to 16,847 men and 1,958 women, who earned in the year $8,483,657. Fuel for heating cost $1,160,152.66. The products for the year were 49,056,253 rose bushes, and 38,380,872 hardy plants and shrubs, while all other plants amounted to 152,835,292, reaching a total value of $12,036,477.76 for plants. Cut flowers brought an additional income of $14,175,328.01.

"From the tabulations in the bulletin it appears that the largest number of square feet of glass in one establishment in the United States is in the District of Columbia; the oldest establishment was started in New York; the largest number of roses propagated were, respectively, in Pennsylvania, Illinois, and Ohio; the largest number of hardy plants propagated were, respectively, in Illinois, New York, and Kansas; the largest total value of plant sales were, respectively, in New York, Pennsylvania, and California, and the largest total value of cut flower sales, respectively, in New York, Illinois, and Pennsylvania.

"In addition to the Society of American Florists 965 state and local floral societies and clubs and 358 horticultural societies, aided by the agricultural and horticultural press, helped to develop this industry to its present large proportions."

DEPARTMENT OF AGRICULTURE, QUEENSLAND.—The following publications of the Department of Agriculture, Brisbane, Queensland, have been received at this office: Bulletin No. 2, Report of the Agricultural Conference of the Agricultural and Pastoral Society of South Queensland, August, 1890. Bulletin No. 3, The Cultivation of Maize, by E. M. Shelton, M. S. (formerly of the Kansas Station). Bulletin No. 5, Canning and Otherwise Preserving Fruits for Home and Market, by E. M. Shelton, M. S. Bulletin No. 6, Tobacco, Its Cultivation in Northern Queensland, by S. Lamb.

LIST OF PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

JUNE 1 TO JULY 1, 1891.

DIVISION OF STATISTICS:

Report No. 85 (new series), June, 1891.—Report on the Acreage of Wheat and Cotton, and Condition of Cereal Crops; Freight Rates of Transportation Companies.

DIVISION OF BOTANY:

Contributions from the United States National Herbarium, Vol. II, No. 1, June, 1891.—Manual of Plants of Western Texas, Part I.

DIVISION OF ENTOMOLOGY:

Periodical Bulletin, Vol. III, Nos. 9 and 10, June, 1891.—Insect Life.

Bulletin No. 25.—Destructive Locusts.

Circular No. 2 (second series), June, 1891.—The Hop Plant-Louse and Remedies to be Used against it.

OFFICE OF EXPERIMENT STATIONS:

Experiment Station Record, Vol. II, No. 11, June, 1891.

LIST OF STATION PUBLICATIONS RECEIVED BY THE OFFICE OF EXPERIMENT STATIONS.

JUNE 1 TO JULY 1 1891.

AGRICULTURAL EXPERIMENT STATION OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF ALABAMA:

Bulletin No. 25 (new series), April, 1891.—Effects on Butter from Feeding Cotton Seed and Cotton-Seed Meal.

Bulletin No. 26 (new series), April, 1891.—Commercial Fertilizers.

Bulletin No. 27, May, 1891.—Black Rust of Cotton.

COLORADO AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 15, April, 1891.—Two Insect Pests.

GEORGIA EXPERIMENT STATION:

Bulletin No. 12, April, 1891.—Field Experiments with Forage Plants, and Analyses of the Products.

KANSAS AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 18, December, 1890.—Experiments with Forage Plants.

Bulletin No. 19, December, 1890.—Germination of Weeviled Peas; Garden Notes on Potatoes, Beans, and Cabbage.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE:

Meteorological Bulletin No. 29, May, 1891.

MISSOURI AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 14, April, 1891.—Field Experiments with Corn.

NEBRASKA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 17.—Field Experiments and Observations for 1890; Meteorological Observations for 1890.

NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION:

Second Annual Report, 1890.

Bulletin No. 13, May, 1891.—Effect of Food on Butter and Quantity of Milk.

Bulletin No. 14, May, 1891.—Silage in Dairy Farming.

NEW YORK AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 32 (new series), June, 1891.—The New York State Fertilizer Control and Fertilizer Analsyses.

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 27, May, 1891.—The Production and Care of Farm Manures.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION:

Bulletin No. 77, May 1, 1891.—Value of Pea-Vine Manuring for Wheat.

OHIO AGRICULTURAL EXPERIMENT STATION:

Bulletin Vol. IV, No. 2 (second series), February, 1891.—Miscellaneous Experiments in the Control of Injurious Insects; Some Common Cabbage Insects; Three Important Clover Insects.

The Pennsylvania State College Agricultural Experiment Station:
Annual Report, 1889.

Tennessee Agricultural Experiment Station:
Bulletin Vol. III, No. 6, December, 1890.—Index to Volumes I and II.
Bulletin Vol. IV, No. 1, January, 1891.—Crab-Grass Hay; Sorghum as a Forage Plant; Test of Feed Value of First and Second Crop of Clover; Pasture Grasses; Black Knot of the Plum and Cherry; Pruning Fruit-Trees; The Glassy-Winged Soldier Bug; Diseases of Live Stock; Experiment Station Record.
Bulletin Vol. IV, No. 2, April, 1891.—The Pea-Nut Crop of Tennessee, Statistics, Culture, and Chemistry

Texas Agricultural Experiment Station:
Bulletin No. 14, March, 1891.—Effect of Cotton Seed and Cotton-Seed Meal in the Dairy Ration on Gravity and Centrifugal Creaming of Milk.

Agricultural Experiment Station of Utah:
Bulletin No. 6, May 15, 1891.—Trial of Sleds and Tillage Tools.

Vermont State Agricultural Experiment Station:
Bulletin No. 24, May, 1891.—Potato Blight and Rot.
Bulletin No. 25.—The Bounty on Maple Sugar.

West Virginia Agricultural Experiment Station:
Bulletin No. 13, January, 1891.—The Creamery Industry.
Bulletin No. 15, March, 1891.—Raspberry Gouty-Gall Beetle.

Wyoming Acricultural Experiment Station:
Bulletin No. 1, May, 1891.—The Organization and Proposed Work of the Station.

DOMINION OF CANADA.

Department of Agriculture:
Bulletin No. 10, April, 1891.—Treatment of Apple Scab, and Grape and Gooseberry Mildew.
Bulletin No. 11, May, 1891.—Recommendations for the Prevention of Damage by Some Common Insects of the Farm, Orchard, and Garden.

Ontario Agricultural College Experiment Station:
Bulletin No. 63, May 15, 1891.—Pitting the Sugar Beet.
Bulletin No. 64, May 28, 1891.—Silage and Roots for Swine.
Bulletin No. 65, June 15, 1891.—Ginseng.
Bulletin No. 66, June 22, 1891.—Variations in the Fat of Milk.

Bureau of Industries, Toronto, Ontario:
Bulletin No. 36, May 1, 1891.—Crops and Live Stock in Ontario.

INDEX OF NAMES.

INDEX OF SUBJECTS.

NOTE.—This index is intended to serve as a guide to the contents of the publications which are referred to by page and number in the body of the Record.